Proceedings of the American Academy of Arts and Sciences.

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(Title Page and Table of Contents.)

RECORDS OF MEETINGS.

Nine hundred ninety-ninth Meeting.

OCTOBER 12, 1910. — STATED MEETING.

The PRESIDENT in the chair.

There were forty-five Fellows and one guest present.

The following letters and circulars were read by the Corresponding Secretary: — letters from Messrs. Archibald C. Coolidge, Roland B. Dixon, Worthington C. Ford and Edward C. Moore, accepting Resident Fellowship; from Sir David Gill, accepting Foreign Honorary Membership; a notice from his family of the death of F. von Recklinghausen; from the Instituts Solvay, asking recognition of the new society; from the tenth International Congress of Geography to be held in Rome in October, 1911; a notice of the formation of a society for the development of experimental sciences, in connection with the Imperial Moscow University; a circular notice to the President of the Academy that he had been elected a member of the organizing Committee for the Eighth International Congress of Applied Chemistry, to be held in the United States in 1912; a request from the Director of the Civic Pageant of the Boston 1915 organization for assistance for the Pageant, to be held in November; a program of the first Universal Race Congress, to be held in London, July 26-29, 1911; a notice of various International Horticultural Expositions to be held in Turin in 1911, in connection with the International Exposition of Industry and Labor; a letter from Professor Hugo Münsterberg to Professor Watson, announcing the formal opening of the Amerika-Institut of the German Government.

The Chair announced the following deaths: Robert Amory, Resident Fellow in Class II., Section 3; George P. Fisher, Class III., Section 3, and Melville W. Fuller, Class III., Section 1,

Associate Fellows; Frederick J. Furnivall, Class III., Section 4, and F. von Recklinghausen, Class II., Section 4, Foreign Honorary Members.

The following gentlemen were elected Resident Fellows:

Alfred Church Lane, of Cambridge, Class II., Section 1 (Geology, Mineralogy, and Physics of the Globe).

Winthrop John Vanleuven Osterhout, of Cambridge, Class II., Section 2 (Botany).

Dr. Louis Bell called the attention of the Academy to the fact that the next meeting would be the one thousandth meeting of the Academy.

It was

Voted, that a committee be appointed to consider the celebration of the event.

On motion of the Recording Secretary it was

Voted, to meet on adjournment, November 9, 1910.

The following communication was given by Dr. Percival Lowell: "Investigations of Halley's Comet at Flagstaff Observatory."

The following papers were read by title:

"Theory of Coupled Circuits, under the Action of an Impressed Electromotive Force, with Applications to Radio Telegraphy." By G. W. Pierce.

"A Revision of the Atomic Weight of Neodymium. First Paper. — The Analysis of Neodymium Chloride." By G. P. Baxter and H. C. Chapin.

"On the Equilibrium of the System consisting of Calcium Carbide, Calcium Cyanide, Carbon, and Nitrogen." By M. de Kay Thompson and R. H. Lombard. Presented by H. M. Goodwin.

One thousandth Meeting.

NOVEMBER 9, 1910. — ADJOURNED STATED MEETING.

The PRESIDENT in the Chair.

There were thirty-eight Fellows and one guest present.

The Corresponding Secretary read letters from Messrs. Alfred C. Lane and W. J. V. Osterhout, accepting Resident Fellowship, and a circular from the Boston Vocation Bureau, announcing

the first national conference to consider the question of the choice of vocations by the young men and women of this country, to be held in Boston November 15 and 16, 1910.

The Council reported that it had considered Professor Percival Lowell's charge that Professor Edward C. Pickering had suppressed information in regard to Professor Lowell's candidate, — Mr. Lampland, — and having considered Professor Pickering's testimony in regard to the same, found that the charge was entirely unfounded, and passed the following vote: — "That the Council has considered the charges presented by Professor Lowell and the new counter-evidence from Professor Pickering, and considers the charges unfounded. The error arose by reason of forgetfulness on the part of Professor Davidson."

The President read the following letter from Mr. G. R. Agassiz:

My dear Prof. TROWBRIDGE,

Percy Lowell has just telephoned me that you were waiting to call a meeting of your American Academy Committee, until you heard from us. You remember that I said that we (my brothers and I) thought it advisable not to make a formal proposal till we were in a position to pay the bequest. Matters move so slowly in these matters that it is still impossible for us to say how soon this will be. It certainly will not be before Mr. Bowditch leaves.

You may remember that the question will be for the Academy to decide whether it prefers to have a fund of $50,000 — or the house Mr. Agassiz intended to build for them. Should the Academy decide on the latter alternative (after they have received our proposal) they will doubtless find that the conditions will be something like this:

If they care to devote the $50,000, bequeathed to them unconditionally by Mr. Agassiz, toward building from the plans that Mr. Agassiz had prepared — then his children would pay the rest of the cost — and furnish a suitable fund to furnish the house.

This is in no way an official communication, but is written in the hope of recalling to you what our actions will in all probability be. Furthermore I should like to have this matter known as widely as possible among the members of the Academy, as, should you decide to build, we should doubtless like the assurance that such a course meets with the approval of a very considerable majority of its members.

Yours very truly,

G. R. AGASSIZ.

The following recommendations from the Committee on Policy were read: —

That the Academy hopes in a short time to be in a position heartily to accept the conditions of the Agassiz heirs, informally outlined concerning the building.

1. That the number of Resident Fellows be gradually increased by one hundred.
2. That not more than twenty-five Fellows be added annually, and not over four in any section.
3. That a committee of five, including the President and Recording Secretary, be appointed to take charge of meetings.
4. That the functions of the Council be enlarged in order to give it supervision over all affairs of the Academy.
5. That if, at 8.30, business is in progress, it be postponed, and the communication announced, be called.

No action on the above recommendations was taken by the Academy.

The President appointed Dr. Louis Bell and Professor W. M. Davis a Committee on the Celebration of the one thousandth meeting.

The following communication was given: —

"The Supposed Recent Subsidence of the Massachusetts Coast," by Professor D. W. Johnson.

The following papers were presented by title: —

"The Pegmatites of the Riebeckite-Aegirite Granite of Quincy, Mass.; their Minerals, Structure and Origin." By C. H. Warren and Charles Palache.

"The Vector Diagram of the Oscillating-Current Circuit." By A. E. Kennelly.

"Infinitesimal Properties of Lines in S_4 with Applications to Circles in S_3." By C. L. E. Moore. Presented by H. N. Tyler.

"The Indeterminate Product." By H. B. Phillips. Presented by H. N. Tyler.

"A Fundamental Theorem Regarding Curves on Reguli." By W. E. Story.

"The Action of Mercury on Steel at High Pressures." By P. W. Bridgman. Presented by John Trowbridge.

One thousand and first Meeting.

DECEMBER 14, 1910.

The Academy met at the University Club, to celebrate its one thousandth Meeting.

The PRESIDENT in the chair.

There were present seventy-five Resident Fellows, one Associate Fellow and twenty-two guests.

The dinner was typical of colonial times — being copied largely from one given on Forefather's Day in Plymouth, 1769. The menu, which is of historic interest, follows on page 688:

After the dinner the President, Professor John Trowbridge, congratulated the members upon the large attendance which testified to the vitality of a body which, after 130 years, could show such strength, and called upon the Recording Secretary to read the record of the last meeting. Several members objected, and desired the record of the first meeting. This was accordingly read, as follows:

May 30, 1780. By an Act of the Great and General Court of the State of Massachusetts, passed y^e^ 3^d^ of May, 1780, a Society was incorporated and established by the name of American Academy of Arts and Sciences. In the Act, the Philosophical chamber in the University of Cambridge was determined to be the place where the Fellows of the Academy should hold their first meeting and the Honorable James Bowdoin Esq^r^ was authorised and impowered to fix the time for holding the said meeting and to notify the same. He having done this by advertisement in the public newspapers the fellows of the said Academy held their first meeting at the place aforesaid on the 30^th^ of May, 1780.

At the meeting the Act of Incorporation was first published. The Rev^d^ President Langdon then prayed, after which the Fellows passed the following votes: —

1. That the Honorable James Bowdoin, Esq. be President until the next meeting of the Academy.

2. That M^r^ Caleb Gannett be Secretary until the next meeting of the Academy.

3. That Ebenezer Storer, Esq^r^ be Treasurer until the next meeting of the Academy.

4. That the Honorable James Bowdoin, Esq^r^, Mr Caleb Gannett, the Rev^d^ Samuel Langdon, D. D., the Honorable John Pickering Esq^r^.,

THE REPAST

A Baked Indian Whortleberry Pudding

SALMON AN OYSTER PYE

A Veniſon Paſty

A HAMM RABBIT & ONIONS

CYDER PVNCH

Turkeys, Roſt

PEASE BAKED BEANS

A DISH OF SVKOVTTAHHASH

Divers Pyes

JELLYS & SVLLABVBS CRANBERRY TARTS

CHEESE

Stephen Sewall, Esq^r., the Rev^d Edward Wigglesworth & the Rev^d Samuel Williams, be a Committee to agree upon the names, number and duties of the several officers they shall judge necessary or convenient to the Academy and the tenure or estate they shall respectively have in their offices: Also to prepare such rules, orders and bye-laws, as they shall judge necessary or convenient for the well-ordering and good government of the Academy. Also to consider of the times, places and manner of convening the Fellows of the Academy and the number of Fellows which shall be present to constitute a meeting of the Academy: to devise a common seal for the Academy, to consider for what causes fines shall be levied & what the fines shall be, and to report their proceedings upon the premises at the adjournment of this meeting.

5. That this meeting be adjourned to the second Wednesday of July next at ten o'clock in this place.

The President called attention to the words in the minutes, "The Rev. President Langdon then prayed," and asked Rev. Edward H. Hall if he could remove an odium scientiæ from the academy in abandoning this custom — in the hope that he would assure the members that although they were birds of passage — lone wandering — they were not lost.

Reverend Mr. Hall then spoke as follows:

The Revd. President Langdon then prayed.

It is well that the ravages of time have preserved for us this brief statement, for so far as appears, that was the first and perhaps the last time that the divine blessing was invoked within the Academy walls. There was no special intent in this, for the absence of prayer was by no means unknown in the early Puritan gatherings, and we find Governor Bowdoin, the first president of the Academy closing his inaugural address with a full evangelical invocation of almighty favor and support; at the same time, in view of the perfunctory character so often assumed in this service, it is a satisfaction to remember this relation of religion to science through the whole history of the Academy; each paying due honor to the other with as little intrusion as possible into the other's domain. Science I suppose pays best homage to religion by showing its reverence for the laws of the universe without attempting to force its spiritual interpretation upon them.

Meantime it is pleasant to note that the American Academy turned at once to Harvard College in initiating its career. The Rev. Samuel Langdon was not one of the most noted of our early presidents.

Falling as it did in the stormy hours of the incipient Revolution, his administration was broken from the start by the turmoil of war and the constant removals of family and possessions from town to town, from Cambridge to Watertown, to Concord, and again to Cambridge. So disturbed was the college life that all public ceremonial was restricted, and President Langdon entered upon his office without any formal inauguration. Even lottery tickets, the collegiate resource in days of need, remained on the hands of the authorities unsold, and the Corporation had to purchase two thousand tickets on their own account. The college needed a firm hand at the helm, and there is reason to think that this quiet country parson, called from a Portsmouth parish, notwithstanding his fine intellectual quality and ample learning, found himself hardly in his element among exuberant students aflame with patriotic ardor. No serious outbreaks are recorded in Langdon's time, it is true; but the college officials were pained early in his administration, when the Tory students amused themselves by "bringing India tea into commons and drinking it to show their loyalty."

On the whole, however, the brief period of Langdon's presidency passed quietly, reflecting honor upon the president's scholarship and learning, as well on the whole as on his administrative zeal. He was by no means lacking in public activity, taking his full share, if the accounts are correct, in the political affairs where college and state had to act together. He is credited with an active part in 1779 in framing the three articles of the constitution confirming the privileges of the college and defining the change in the position and functions of the Overseers. The provision whereby, in connection with the Governor, Council and Senate, the ministers of the Congregational churches of Cambridge, Watertown, Charlestown, Boston, Roxbury and Dorchester succeeded to the functions of the Board of Overseers, has hardly vindicated its wisdom, and has long given way to something better, but otherwise the interests of Harvard College have found themselves admirably guarded by the constitution of 1779.

Such being the condition of college affairs, it was with great astonishment that the Corporation Aug. 29, 1780, received the resignation of President Langdon after six years' service. Nothing had pointed to this event, the college was in no crisis, nor was any special cause given by the president for this sudden withdrawal from his post. In a letter of singular dignity and detachment, free from all accusations, and dwelling with simple pathos upon the hopes of greater usefulness which he had cherished in "serving the noble cause of country and liberty, and the important interests of Religion and literature," dwelling also upon the "severe labors he had gone through since entering

upon his office," he declares that his "taste for youthful studies is decreasing" and pleads for a "more retired situation." The next day a meeting of the Overseers was called, no discussion seems to have followed, no regrets were expressed, the Overseers simply voted their thanks and acknowledged the value of his services, and the resignation was accepted. It reads as if the Corporation and Overseers were so accustomed to presidential resignations that no formalities were thought necessary, and the only thing to do was to choose a new head and start afresh.

What did it all mean? Of course there was more than appeared upon the surface, and by degrees a situation disclosed itself altogether unique in the annals of the college. So far as appears the relation of the president to his students was friendly and their respect for his scholarship and learning was great; but religious and political dissensions were rife, and the students caught many of the catch-words of their elders. He was thought skeptical and called by some a deist. Apparently a small body of students, otherwise discontented, took up these charges and formed a combination against him. A meeting of the three upper classes was called, and resolutions were unanimously passed, charging President Langdon with "impiety, heterodoxy, unfitness for the office of preacher of the Christian religion, and still more for that of President." Twelve students were appointed to wait upon the President and invite him to resign his office. Two days afterwards he detained the students after morning prayers and, with unexampled humility, told them that he should resign (Quincy ii. 179). At once, the solemn crisis having passed, these same students, with equal unanimity, passed resolutions of entire confidence in his ability and character, and great sympathy with his needs.

In this extraordinary episode it is easy for those who are acquainted with student life to trace fairly well the probable course of events. With all sympathy with the weary and tormented president, we cannot help detecting in his immediate surrender to the situation, in the very absence of recrimination or reproach, and his quick retirement from the contest, the evidence of fine scholarly instincts perhaps, but of a man consciously out of place amid the rudenesses and frequent brutalities of college life. It was evidently President Langdon's misfortune to be called out of the quiet of a country parsonage into the turmoil of the American Revolution. With these singular incidents in our thoughts, it is easy to understand why one of his biographers, cited by Quincy, declared that President Langdon "wanted dignity and authority," another "that he wanted judgment and a spirit of government."

With this single event of Samuel Langdon's career, almost the only

important one that history has preserved, we take our leave of the 16th President of Harvard College. Slight as it is, it presents the college in a curious light, and in no respect more curious than in its relations with the patient president who bore himself with such scholarly calm through the turmoils of riotous days. It is pleasant to remember that the last seventeen years of his life, from 1781 to 1797, were spent in the congenial seclusion of a small country parsonage.

After the completion of Mr. Hall's address, the President read the following letter from Professor William W. Goodwin, a former President of the Academy.

Some of the pleasantest recollections of my first years as Tutor and Professor are connected with the Academy, of which I was made a member by the kindness of my beloved teacher and friend, Cornelius Conway Felton, soon after I returned to Cambridge from Germany in 1856. I shall never forget the enjoyment of the earliest meetings which I attended. The first was at the house of Dr. Jacob Bigelow, then President of the Academy. Another memorable Meeting was when the venerable Ex-Vice-President, Josiah Quincy, invited the Academy to his house on Park street (I think it was on his ninetieth birthday), and entertained us by reminiscences of his early life in Boston and of his Presidency of Harvard College. After the meetings the Cambridge party, among whom were apt to be Professors Felton, Lane, Lovering, Agassiz, and Jeffries Wyman, with Morrill Wyman, B. A. Gould and others, hastened to Brattle street and filled the Cambridge omnibus to overflowing; or occasionally, when the moon was full, made up a party to walk home to Cambridge.

At about this time a controversy arose between some of its members who felt that the increasing interest taken in the social meetings in private houses interfered with the more important scientific duties of the Academy as a learned society, and those who (like Professor Felton) "could see no harm in a glass of wine and an oyster." The social meetings became less and less frequent, however, when the Academy became more pleasantly settled in quarters of its own, and now, when we have a comfortable home in our own house in Boston, the old controversy has become a matter of early history.

I beg you to present to the Academy my deep regrets that I cannot be with them on Wednesday evening. As one of its older members, one who remembers always with pleasure that he had for a few years the honor of being its President, I feel a just pride in its honorable and useful past; and I hope that, as the years bring round the anni-

versary of its two thousandth meeting, the members then assembled may be able to feel that its traditions of fruitful work in the cause of science and the arts have been faithfully preserved and its field of useful service to humanity has been much enlarged.

The Corresponding Secretary, Professor Edwin H. Hall, was next called upon to report recent correspondence of the Academy; but on account of the commemorative character of the meeting, he excused himself from the current correspondence, and instead, presented to the meeting three letters received by the Academy one hundred and thirty years ago. These letters follow:

JAMAICA PLAIN JULY 8th 1780.

SIR,

Permit me, as a Friend to all Establishments which have a Tendency to promote useful Knowledge, to congratulate you upon the Institution of the American Academy of Arts and Sciences; and to add my warmest Wishes for the Success of so laudable a Design.

As it will doubtless be a Part of the Society's Plan to form a Museum of the natural Productions of the Country, as well as to investigate the Properties of each, and the Uses to which it may be applied, I beg Leave to send you a Piece of the Asbestos, and some Pyrites, both Natives of Pennsylvania. The former I received from the ingenious David Rittenhouse, Esquire, who informed me he had used some of the Filaments of it (soon after it was taken out of the Earth) as Wick for a Lamp; but having been long exposed to the Air, it now wears the Appearance of the Petrefaction. Even in this State it is fissile, and may be easily split length-wise.

The Pyrites I collected at Lancaster, where they are found in great Plenty: they contain Sulphur; and, notwithstanding the Regularity and Polish of some of them, are in their natural State.

My employment under Congress, as Surveyor General of the Post Officies and Roads in the Eastern District, frequently affords me Opportunities of collecting Specimens of various Kinds; and should these now sent prove acceptable, I shall take the Liberty, from Time to Time, of adding others as they occur.

I have the Honor to be, Sir

Your most obedient and very humⁱ Servᵗ

EBEN HAZARD

Boston, Novr 6th 1780.

Honoured Sir,

As I find my Name inserted among the names of the Members of the *New Academy* erected among us; and I perceive your Honour to be the chosen President of it; I think it my Duty to inform you, and so the Academy, that I esteem it honorary to be reckoned worthy to be placed as a Member among you.

I am too far advanced in Life to attend the Meetings of the Academy. And although I dare not form the Wish, *O mihi praeteritas referat ut Jupiter Annos!* yet I must own that, if I was thirty or forty years younger, it would have been a much greater Satisfaction to me to have been numbered among you.

However I am heartily willing and strongly desirous, as far as it may be in my Power, to promote the Design, and support the Credit, Reputation and usefulness, of the Society.

And, in order to show my Good-will and Respect in the Body I have hastily collected the Methods and Rules, that have been proposed to be observed and followed by two foreign Academies; and have added a Proposal or two of my own.

And, if the Academy, over which I trust you will worthily preside, should think it worth the while to ask me to employ my Thoughts or use my Pen, on any Subject that may be subservient towards a Furtherance of the Arts and Sciences; I shall endeavour, as old as I am, by the Divine Will and Assistance to comply with the Requisition from them.

One of the *Academy of Sciences at Paris*, it was I think Mr *Frontenelle*, called the Same *Une Corpse des Esprits*, A Body of Spirits, or Geniuses: I wish from my Heart, that our Academy may prove and continue to be, such a Body, to their own Honour and the Enlightening and Rejoicing of Others.

I wish you Honoured Sir, and all the Brethren of our Academy, the Presence and Blessing of Heaven in all your Projections and Endeavours to promote useful Sciences, as well as at the same Time Religion and Virtue; and am, with great Respect,

Your most humble and obedient Servant

Samuel Mather.

P. S. I found your Honours Name among the first Members of the French Academy: But he spelt it Baudoin: Which seems to be the right way of Spelling it. He was a learned Man.

LONDON, July 21st 1781.

DEAR SIR,

I think myself much honoured by the favour of your letter dated the 28th of Febr last wch I received about a month ago. I am made very happy by the information it contains, that in the midst of war and the most important struggle that a people were ever engaged in, a new Academy for promoting arts and Sciences has been established at Boston. In compliance with your desire, I have communicated the incorporating Act and list of members to the President and Secretaries of the Royal Society, attended with a letter of my own stating the contents of your letter to me, and the hopes wch the American Academy entertain that the Royal Society, governed by the neutrality of Philosophy, will favour it with its encouragement. I do not yet know certainly what notice will be taken of these communications. The reply that has been reported to me from the President is, that it has not been customary to lay before the Royal Society notices of the institution of any Societies whatever.

I am obliged to be cautious in communicating the inaugural oration of your honourable and worthy President on account of some political passages in it. For my own part I approve and admire these passages; and I request the favour of you to deliver my best respects to the Author. I have delivered your letters to Dr Morell and Mr Maskelyne. I have likewise got a Friend to communicate to the Society of Arts and Commerce the copy of the incorporating Act which you intended for them.

I am at present very busy in preparing for the Press a fourth edition of my Treatise on Life-annuities and Reversionary paymts I shall enlarge it to two volumes, and when out to Press (wch I am afraid will not be till the beginning of next Summer) I shall endeavour to get it convey'd to you in hopes of the honour of its being accepted as a testimony of my respect for the American Academy. This work having been of some use I am anxious about making it as complete as possible. With this view I am collecting all the Observations I can get on population, the increase of mankind, and the duration of human life in different Situations.

All that can be worth communicating to you in the Philosophical and Astronomical way is published in the numbers of the Philosophical Transactions of the Royal Society which come out every half year. What has lately most engaged attention is the new Star discovered near Auriga by Mr Herschel, a gentleman at Bath, who has for some time been very curious and diligent in watching the Heavens. This

Star was at first taken for a comet; and the Astronomer Royal once expected that it would have passed over the disk of the Sun at the beginning of last month. But he has since told me, that it is doubted whether it may not be a planet never before discovered moving at a much greater distance from the Sun than *Saturn*. It has been for some time hid by the Sun's rays. Should it appear again, Something more certain will probably be determined concerning it.

D^{r} Priestly never went farther in his History of Philosophy than Electricity and Optics. He has been for some time wholly employed in making experim^{ts} on the different Sorts of air. In this branch of Philosophy he has made several very important discoveries, an account of which he has given in five Octavo Volumes, the last published this Summer. One of the most important facts which he has discovered is the effect of vegetation, aided by the action (not of *heat* but) of *light* in purifying, preserving and restoring common air constantly injured and diminished by the breathing of animals, the burning of fires, putrefaction and other causes. In the day time and particularly in Sunshine, the purest kind of air is emitted by the leaves of trees and all vegetables; and this emission is more or less copious in proportion to the vigour of the vegetation and the force of the Sun's light. In the night and in the dark it ceases entirely. D^{r} Priestly is going on with these experim^{ts}, and very probably another volume will be published in a little time.

If you think that my best respects and wishes will be acceptable to the members of your Academy, I beg you would deliver them. No one can observe with a more earnest attention than I do all that now passes in America. With much gratitude and the greatest regard I am, S^{r}, your most obedient and humble Ser^{t}

RICH^{D} PRICE,

Deliver my very respectful complim^{ts} to the venerable D^{r} Chauncy. D^{r} Winthrop was my correspondent. With pain I reflect that he is no more in this world to promote virtue, liberty and Science. But we are all following him. God grant that we may leave the world wiser and better for us.

A copy of this letter was sent by another conveyance.

The President called attention to the rich store of historical documents possessed by the Academy, of which the letters read were but a small portion. There are letters from General Washington acknowledging his election to the Academy; a letter from Priestly, the discoverer of oxygen; several from Count Rumford, and a host of others.

The paper announced for the evening was on "Earthquakes"; but Professor Jaggar, who was to present it, moved that in consequence of the festivities it be omitted.

The President introduced the toastmaster of the evening, Professor E. C. Pickering. Professor Pickering spoke as follows:

This is the third celebration of its kind by the American Academy of Arts and Sciences. The first, eighty years ago, the Semicentennial, also included a dinner. My knowledge of it is derived only from hearing it discussed fifty years later. The second celebration, the Centennial, is well remembered by many of us. When the American Academy was founded in 1780, there was only one scientific society in America, the American Philosophical Society, founded thirty-seven years earlier, at the initiative of Franklin. Curiously enough, just thirty-seven years later, the third Society of its kind was established, the New York Academy of Sciences.

Of the sixty-two charter members of the American Academy, three were under thirty years of age, and two were over seventy. The Academy once elected a man who was twenty-one years old, and thus came within four months of having a member who was legally an infant. Youthful membership led to long terms, the longest, that of Dr. Jacob Bigelow, extending over sixty-seven years. The shortest, of but a few hours, was that of Mr. Horace Mann. It gave him much pleasure to learn that he had been elected, although he died the same night. The term of one of the charter members, Theodore Parsons of Newbury, appears to have been negative, as he is stated to have been lost at sea in 1779, the year before the Academy was founded. The terms of several of our members have exceeded half a century, including those of three now living. The term of the senior member, Professor Francis H. Storer, fifty-three years, exceeds by a few minutes only that of his twin member, President Eliot. Our former President, Professor Goodwin, has been a member for fifty-one years.

The usefulness, in fact the justification, of an Academy like this is not in holding meetings, or in reading scientific or literary papers. Such work is only local and temporary. The real objects of the Academy should be the increase and diffusion of knowledge, the first by research, the second by its publications. Research is the most important of all. I take great pride, as a member of the Rumford Committee for nearly forty years, in the list of investigations we have been able to aid. But it is pitiable to consider the many cases that have come before the Committee where admirable work must be abandoned for lack of a few hundred dollars. No more valuable contribution to Science,

or memorial to this meeting, could be made than the gift to the Academy of a Fund, whether large or small, to be administered like the Rumford Fund, but without the conditions which sometimes restrict the usefulness of that most valuable gift.

About thirty years ago, the Proceedings of the Academy filled twenty volumes, and its Memoirs ten. At that time I urged the preparation of an index to the whole, as the principal objection to publication in our Proceedings is that papers are buried in them, and are likely to be forgotton or overlooked. The need of such an index is much greater now than at that time. We shall soon have filled fifty volumes of Proceedings, and fifteen of Memoirs.

The first toast I shall propose to you is "The Foundation of the Academy." This is a question of History, and the Academy has a vigorous younger sister, the Massachusetts Historical Society, which is still in the prime of life, since it is but a little over a hundred years old. Many persons are active members of both societies, and I will ask one of them, Mr. Andrew McFarland Davis, to respond to this toast.

The paper of Mr. Davis contained the following interesting account of the incorporation of the Academy and of the time when it came into existence: —

The place at which the first meeting of the Academy should be held, was designated as the philosophical chamber of the University of Cambridge. This was in all probability the Jefferson Laboratory, rather than the Emerson Hall, of that day and was undoubtedly under the roof of the present Harvard Hall. Rev. Samuel Williams, who had succeeded John Winthrop as Hollis Professor of Mathematics and Natural Philosophy, was one of the incorporators of the Academy. He had accompanied Winthrop to Newfoundland twenty years before to observe the transit of Venus, and later he had given lessons in Natural Philosophy to Benjamin Thompson, better known by the title which he afterward acquired of Count Rumford.

To a certain extent the definition given of the purposes of the Academy betrays the limitations imposed upon investigators of those days by their surroundings, their education and the primitive state of knowledge on most of the subjects, to the study of which they promised their attention. Eighty-seven per cent of the persons named in the act of incorporation were graduates of Harvard College. A glance at the curriculum of that institution ought to show how far this body of men, who it may be inferred from the language of the preamble to

the act were regarded as men of genius and learning, had been furnished opportunity for special preparation to cope with the numerous questions suggested in this list.

The Hollis professorship of mathematics and natural philosophy, founded in 1727, provided the only instructor in that institution whose function it was to deal with any of these topics. Professorships instituted after that date could have had no influence in the mental preparation of these investigators but it may be of interest to note the slow awakening of the college to the necessities of students along these lines. A professorship of Chemistry and Materia Medica was instituted in 1783; of Natural Religion, Moral Philosophy and Civil Polity, in 1789; of Natural History, in 1805; of Sciences applied to the useful arts, in 1816; of History, ancient and modern, in 1839; and of Astronomy and Mathematics, in 1842.

The annual income which the Academy could receive was limited to £500 from real property and £2,000 from personal. This measure of value was in silver at 6*s*. 8*d*. per ounce, and amounted to a little less than $8,500. The annual dues were to be paid in Spanish Milled dollars in specie or an equivalent in bills of the current exchange.

The seal of the Academy was not adopted for some years thereafter. The erect figure upon it represents Minerva. Instruments of husbandry, as well as a quadrant and a telescope, are to be seen in the foreground. A corn-field to the left, a town in the distance; a ship under sail approaching it; overhead the sun rising above a cloud. Of this seal those who were describing it said: "The device represents the situation of a new country depending principally on agriculture, but attending at the same time to arms, commerce and the Sciences." One correction in the language used in this description suggests itself. The word "arms" in the phrase "arms, commerce and the sciences," should obviously be arts. The peculiar growth in the lower left-hand portion of the seal represents the corn-field, and was intended to be symbolical of agriculture. Commerce found recognition in the ship and science was obliged to content herself with the quadrant and telescope.

Elections in the Academy were in those days formidable affairs. The polls were to be opened at three P. M. and after the choice of scrutineers, the ballotting was to begin. The ballot box was to remain open until five P. M. and was then to be closed. The voter was required to fold his ballot and hand it in this form to the President, whose duty it was to put the ballot in the box and at the same time to check the name of the voter upon his list of members. A majority was required for election. Ties were settled by drawing lots.

The relations of the Academy to the public in those early days were absolutely different from the aloofness and reticence which prevail to-day. The aid of outsiders was deliberately sought for, and the results were communicated to the newspapers of the day. The records for January 31, 1781, show that "The Reverend Samuel Williams, having been directed by the Council to prepare an invitation to the public to communicate to the Academy any experiments, observations and productions of nature or art, adapted to the ends of its institution; and to lay the same before the Academy at the next meeting for their approval, in order to its publication; reported as follows:

"The Academy have the pleasure to inform the public that they have received the following communications, viz." Then follows a list of papers submitted at the meeting. Notices of meetings were required to be published.

Our associate, Abner C. Goodell, has collated in a note in the edition of the Province Laws which he edited, a few facts relative to the proceedings which took place prior to the passage of the act incorporating the Academy. It appears that on the 21st of March, 1776, a resolve was passed in the Continental Congress recommending to the "assemblies, conventions, and councils or committees of safety" of the several colonies to "take the earliest measures for erecting and establishing in each and every colony, a society for the improvement of agriculture, arts, manufactures and commerce, and to maintain a correspondence between such societies, that the rich and numerous natural advantages of this country for supporting its inhabitants may not be neglected."

So far as our own society is concerned, John Adams claimed to have first suggested its organization, in the course of a conversation with Rev. Dr. Samuel Cooper, at a dinner given in 1779, by the corporation of Harvard College in honor of Chevalier de la Luzerne, the French ambassador, and his suite. In his recollections, written thirty years after the event, Mr. Adams describes how he enlisted the services of Dr. Cooper in the propagation of his idea and plan, which was done so effectually that as he says "the first Legislature under the new Constitution adopted and established it by law." In this statement his memory served him false. We have already seen that the act was passed before the new Constitution came into operation.

In a "country dependent principally upon agriculture," to adopt the language of the person who described the seal of the Academy, before the days of the application of electricity, for power, light or heat; before the development of the steam engine, whether of the stationary or locomotive type; the modes of life, the methods of business, the opportunities for scientific investigation, the subjects to be in-

vestigated, and the methods to be employed were so different from those of to-day that it requires positive effort to reproduce the limitations imposed upon the men of 1780 by their surroundings. Washington is to all intents and purposes as near Boston for us of to-day as was Worcester to our forefathers in 1780, the true measure of the distance being not the number of miles which intervene, but the ease with which they can be traversed. At the time of the revolution, says one writer, the stage-coach was unknown on this continent — a statement open to question, but still so near the truth that it may be quoted for its practical definition of the condition of passenger transportation at that time. Travel was effected either on horseback or in the private chaise, caleche or coach. Communities under these conditions were necessarily provincial, interchange of thought was restricted and there was nothing to stimulate investigation. Real estate and bonds and notes were the only avenues open for investment of funds. When Ebenezer Storer opened his accounts as Treasurer of Harvard College, he charged himself with certain real estate and with two hundred and nineteen personal notes and bonds, the latter being the bulk of the income-yielding property of the College. Turn to the statement of our Treasurer and see the field covered by his investments to-day, and you will have as good a picture of contrast between then and now as can be given. Think for a moment the way in which the opportunity for scientific investigation must have been increased by the utilization of capital as shown on our Treasurer's books.

This period of bucolic simplicity continued for about half a century during which there was no material change in the lives and daily habits of our people. Things were not, however, stationary. This half century saw the beginning of the organization of combined capital. The water power of the country was utilized. Canals were dug. Stage-coach lines were established and the country was prepared for the great revolution which was to follow from the construction of steam railways and the stimulation of industry through the combination of capital in the form of corporations.

Some of us older members of the Academy can remember when the only public method of travel in New England was the stage-coach. As a boy, I well remember the daily passing my father's house of the stage which furnished means for the transportation of passengers between Worcester and Boston. The influence of the development of the facilities for travel since that time are far reaching. The various meetings of scientific men which take place in the holiday season were absolutely impossible then and the world lost the stimulus to research arising from the contact of different persons from different parts of the

country working along parallel lines which must necessarily follow these personal encounters of experts.

If we turn to the records of our meetings of to-day we find that there are presented many papers which are read only by title. Not a few of us have envied our Recording Secretary for the faculty which he possesses of reading with rapid facility the titles of these papers, the obscure terms of some of which convey no information to the hearer of the subject of the investigation, and leave no other impression behind than doubt as to whether there can be many persons beside the writer who can tell what the paper is about. This brings to our attention the fact that with the growth of scientific knowledge there has come partition of subjects and specialization of investigations. Every man no longer knows everything. The farmer of to-day is not necessarily carpenter, blacksmith, harness-maker and cobbler as well.

The change that has been produced within the period of my own life, in our social, industrial and scientific conditions by the mere development of photography is in itself an adequate explanation of the rapid progress in knowledge which has brought about the contrast between the simple earnest groping for knowledge on the part of our forefathers and the marvellous studies in the region of the incomprehensible submitted for our consideration to-day. Before the days of Daguerre, the portrait, the miniature, and the black silhouette were the only means at command to register the likeness of a relative or friend, the inadequate silhouette being the substitute for the snap-shot. Strip from the walls of our homes the records at different periods of life of the appearance of the several members of the family, what a void would be left in the household! The industrial arts, astronomy, the diagnosis of diseases, the study of the motion of animals and of birds, indeed pretty much every form of scientific study, has found the use of the photograph contributory to its advance. An aviator — if the word is permissible — crosses the English Channel. The camera records his flight and his picture — in mid-air, high above the water of the channel — is published in an illustrated magazine. A would-be assassin assaults a distinguished public officer, on the crowded deck of an outgoing steamer. The picture of the scene is secured while the smoke still hangs round the barrel of the pistol and is laid before the readers of a daily newspaper. The ineffectual efforts of a favorite foot-ball eleven are captured and offered by the Sunday papers as a feeble solace to their disappointed admirers.

All this is familiar to every one and all know that photography is but one of a number of scientific accomplishments, the development of which has helped to bring us where we are. The story of their progress

serves to emphasize the difference between scientific knowledge and scientific possibilities in 1780 and in 1910.

The advance of our investigators has carried them farther and farther from the central starting point of ignorance on the radius which measures the circle of knowledge, but with every outward step that has been taken the contact of the circumference of this area of conquered territory with the unknown beyond has become larger and larger. The proceedings of the thousand meetings of the Academy contain a record of the conquest of a large part of the field which we now occupy and there is no sign as yet that our students flatter themselves that the unconquered space of the beyond has given up all its secrets.

Following Mr. Davis's address the Toastmaster called for the second toast:

The second toast I propose to you is "The First Extant Communication Presented to the Academy." There is one name, more prominent than any other in the science of Physics, which has repeated itself in different individuals, in no way connected with each other. There is no danger that this Academy will forget the name of Benjamin Thompson, Count Rumford, the greatest name in science that America produced during the eighteenth century, with the possible exception of the other Benjamin — Franklin. In the nineteenth century, Sir William Thomson stands preëminent, now better known as Lord Kelvin. At the present time, no name stands higher than that of Sir Joseph Thomson of Cambridge, England, the worthy successor of Maxwell and Rayleigh. All three Thomsons were Foreign Honorary Members of this Academy, but to them we may add a fourth, who like Lord Kelvin gave a practical turn to his work. I will ask Professor Elihu Thomson to respond to this toast.

Professor Thomson responded as follows:

The first Academy paper, brief as it was, dealt with an extremely important subject, the making of steel. It was an art comparatively new to the Western world. Reliable information was needed, and this the paper furnished. There is no occasion to dwell upon the present importance of this art for it now dominates all our industries. The United States stands preëminent to-day as a steel producing and consuming nation. Indeed, our great manufacturing industries, our railroads, our steamships, our electrical plants, and our buildings largely rest, so to speak, on foundations of iron and steel. The telegraph

shapes its signals by an iron magnet. Even the telephone speaks to us through a steel magnet and an iron diaphragm.

The earth itself is probably mostly composed of iron, for we have reason to believe that we are living on a layer of cooled and modified slag surrounding a still hot spherical iron ingot five thousand miles or more in diameter, the product of the celestial furnaces. We get our usable iron from the surface flecks of rust here and there.

The art of steel making, as first practiced, was merely an art. There was no science to assist, as it long antedated metallurgical science. The processes were the result of accident or empirical trials. Only within the half century just passed has steel production been brought under control of scientific methods, and only within the past twenty-five years has there been reached a just understanding of the nature of the changes involved. That singularly valuable property of true steel which enables its hardness, elasticity and toughness to be adjusted by a simple heat treatment, has received its explanation. There is no need to emphasize the enormous importance of the property of hardening and tempering which is the characteristic most prized in tool steel. Chemical analysis and microscopic examination of etched faces or sections have revealed in large measure the actual structure of the steel in its various states. Such microscopic examination constitutes the comparatively new science of metallography, which has in recent years contributed so much to our knowledge of metals and alloys, but more particularly the structure of steel.

We now know that not only is steel a complex product, but that its properties, as varied by hardening and tempering, or heat treatment, depend upon the greater or less predominance and upon the distribution of certain chemical constituents, the relative amounts of which are not the same even in the same bar when heated to different temperatures. Names are given to these constituents; ferrite, cementite, pearlite, martensite or hardenite, graphite; and they are, except the last, composed of iron associated with certain proportions of carbon in combination. By sudden cooling of red hot steel to harden it, we catch and fix, as it were, the components in their relation as existing in the hot metal, and before they can adjust their proportions to correspond with that normal to cold metal. In the hot metal so fixed by sudden cooling, there is a preponderance of a hard constituent, martensite or hardenite. If the hot steel had been slowly cooled, then there is time for a reproportioning in which the hard martensite disappears and gives place to a mass composed largely of softer constituents.

Still more valuable is that property of tempering, without which steel tools would be either too hard and brittle, or too soft and flexible.

By moderate reheating of chilled and hardened steel a partial change from the unstable hard condition may be effected; a partial recovery of the condition and proportion of constituents normal to soft or slowly cooled steel. This is tempering, and allows just such a degree of hardness to be retained as is needed, while the brittleness is diminished.

A curious physical fact recently found by Prof. Carl Barus is that during the lapse of a sufficient time all hardened steel will anneal or soften itself automatically, even at ordinary temperatures, but that the change will be accelerated as we raise the temperature. Fortunately the period for this self annealing in the cold is long; but it follows that if we were to dig up steel tools which had been hardened say two or three thousand years ago, we ought to find them much softer than they were originally.

Our scientific knowledge of steel is, of course, not yet complete. Steels with new constituents and more valuable properties are continually being made. For example may be mentioned the so-called air hardening or high speed steels which have added so enormously to the productiveness of machinery and labor in the working of iron and steel itself, and metals generally. Iron and steel production goes on at a rapid rate of increase. Our consumption per capita per annum is already several hundred pounds, and the amount is larger, if I mistake not, in the United States than in any other country. Perhaps we waste more.

The first Academy paper which I have reread describes that method of steel making known as the cementation process. Even until very recently this was the method almost universally relied upon for the production of high grades of tool steel, but within a decade or so the art of refining steel has reached such an advanced stage that great quantities of fine steel are made in what are known as basic open hearth furnaces. Lastly, the advent of the electric arc furnace, some of them dealing with charges of 30,000 pounds or more at a time, has rendered possible refining at very high temperatures, far beyond those of ordinary combustion furnaces. The more perfect control and exclusion of deleterious gases allows separation of impurities and control of composition so as to ensure the product having the qualities desired. In these furnaces electric arcs are maintained on a scale many thousands of times greater than the arcs used in lighting our streets. The enormous output of heat and light is shut up within the furnace walls, or it would be insupportable, insufferable. Its energy goes to raise the temperature of the molten steel bath, and the energy itself may be drawn from a water power.

As in the case of steel making, many an art has been discovered

more or less accidentally, and then practiced empirically for a long time. When, however, scientific investigation discloses the laws and principles upon which it is founded, improvement takes place, as it has in steel making, by leaps and bounds. In the future, science should lead, not follow. Our Academy formed in 1780 brought together the leaders in scientific thought of the time, and it was organized for the spread of scientific knowledge. Can it not go on from this, its thousandth meeting, doing its part under improved auspices, adding to its influence and importance and assisting in those inevitable great advances which are the promise of the future of science?

The Toastmaster: "The next toast I propose to you is 'The First Research Undertaken by the Academy.' I offer this toast with pleasure, partly because of its professional interest to me, and partly because, as I have already said, I believe that the principal function of this Academy should be research. I will ask my colleague, Professor Robert W. Willson, to respond to this toast."

THE FIRST RESEARCH UNDERTAKEN BY THE ACADEMY.

From the records of the Academy it appears that it was "Voted August 30, 1780, that the Hon. Thomas Cushing, Esqr., The Hon. Henry Gardner, Esqr., and Cotton Tufts, Esqr., be a Committee to confer with the Reverend and Honorable Congregation of the University of Cambridge upon pursuing measures to procure an accurate observation of the Solar eclipse in October next, in the eastern part of this State, and, in case it should be judged expedient, to join with the congregation aforesaid in an application to the Great and General Court for such assistance as may in the best manner affect the design."

Some years ago Dr. B. A. Gould, the founder of the Astronomical Journal, told me that its publication was delayed for six months, to await the completion of a research by Professor Benjamin Peirce on the Development of the Perturbative Function, in order that the issue of the first number, which was wholly occupied by this paper, might show that it was to be a worthy rival of the great European Journal whose field it entered.

In like manner we may look on this first research undertaken by the Academy, as foreshadowing the important place which this Society has since occupied in the development of the Sciences in America.

It may be of interest to know that the first number of the Journal, treating, as it did, of a subject far beyond the comprehension of all but

a very few of the very learned, was probably consigned to the waste basket by most of the recipients, and has at all events become extremely rare. It is in fact lacking in Professor Pierce's own set of volumes of which I am now the fortunate possessor.

Such a fate was not to be feared for the account of our "first research." There must always be a strong popular interest in a total eclipse of the Sun, especially if it occurs so near at hand that it may be seen without a long and expensive journey.

Nowadays we all anxiously scan the newspapers to learn whether our observers, sent half round the world, perhaps, to accomplish their utmost in a short five minutes, have had a clear sky at the critical moment.

The first eclipse of the sun in the present century occurred on the 18th of May, 1911. Its track passed over the Indian Ocean and it was successfully observed at the Island of Mauritius and in Sumatra at about noon of that date. Had direct telegraphic communication been established, this success might easily have been known in Boston in time to be announced in the morning papers and read at our breakfast tables on that same 18th day of May. What would the Rev. Samuel Williams, Hollisian Professor of Mathematics and Natural Philosophy, have thought of this modern miracle! — familiar though he doubtless was with the times of Hezekiah, when the Lord did the thing that he had spoken: "Behold, I will bring again the shadow of the degrees, which is gone down in the sundial of Ahaz, ten degrees backward. So the sun returned ten degrees by which degrees it was gone down."

I select the name of Samuel Williams from the list of Reverend Professors who one hundred and thirty years ago shed a lustre upon the University and formed a considerable part of the membership of the Academy, because he was naturally chosen to be the leader of their expedition.

Successor of the gentle and learned Rev. John Winthrop who had died in the previous year, he taught the Astronomy of his day to such undergraduates as were competent to pursue that vigorous study, and from his pupils six were chosen, together with a graduate who had just taken his degree, as assistants in his observations. His own account is as follows:

"Observations of a solar eclipse, October 27, 1780, made on the east side of *Long-Island* in *Penobscot-Bay*."

"A total eclipse of the sun is a curious and uncommon phenomenon. From the principles of Astronomy it is certain that a central eclipse will happen, in some part of the earth, in the course of every year: But it is but seldom that a total eclipse of the sun is seen in

any particular place. A favorable opportunity presenting for viewing one of these eclipses on October 27, 1780, the American Academy of Arts and Sciences, and the University at Cambridge, were desirous to have it properly observed in the eastern parts of the State, where, by calculation, it was expected it would be total. With this view they solicited the government of the Commonwealth, that a vessel might be prepared to convey observers to *Penobscot-Bay*; and that application might be made to the officer who commanded the *British* garrison there, for leave to take a situation convenient for this purpose.

"Though involved in all the calamities and distresses of a severe war, the government discovered all the attention and readiness to promote the cause of science, which could have been expected in the most peaceable and prosperous times; and passed a resolve, directing the Board of War to fit out the Lincoln galley to convey me to *Penobscot*, or any other port at the eastward, with such assistants as I should judge necessary.

"Accordingly, I embarked October 9 with Mr. Stephen Sewall, Professor of the Oriental Languages, James Winthrop, Esq., Librarian, Fortesque Vernon, A. B., and Messrs. Atkins, Davis, Hall, Dawson, Rensalear, and King, Students in the University. We took with us an excellent clock, an astronomical quadrant of 2–1/2 feet radius, made by Sissons, several telescopes, and such other apparatus as were necessary.

"On the 17th we arrived in *Penobscot-Bay*. The vessel was directed to come to anchor in a cove in the east side of *Long-Island*: after several attempts to find a better situation for observations, we fixed on this place as the most convenient we had reason to expect: And on the 19th we put our instruments on shore, near the house of Mr. *Shubael Williams*, where the following observations were made."

[A note to the foregoing paragraph gives us a clear picture of the difficulties due to the existing state of war:

"As an officer who commanded at Penobscot in his answer to the application of the government, had limited us to a time wholly inadequate to our purpose, from the 25th to the 30th of October, we were obliged to make a second application for leave to enter *Penobscot-Bay*. Leave was granted, but with a positive order to have no communication with any of the inhabitants, and to depart on the 28th, the day after the eclipse. Being thus retarded and embarrassed by military orders, and allowed no time after the eclipse to make any observations, it became necessary to set up our apparatus and begin our observations without any further loss of time. In the course of which we received

every kind of assistance from Capt. Henry Mowatt, of the Albany, which it was in his power to give."]

I pass over these further details of the account which are mainly of interest to professional astronomers, but I should read this early account of the phenomenon which has been referred to since 1836 as "Baily's Beads," after the English Astronomer who described their appearance at the total eclipse of that year.

Professor Williams after recording his micrometric observations of the diminishing width of the solar crescent, continues thus :

"Immediately after the last observation, the sun's limb became so small as to appear like a circular thread, or rather like a very fine horn. Both the ends lost their acuteness, and seemed to break off in the form of small drops or stars; some of which were round, and others of an oblong figure. They would separate to a small distance : Some would appear to run together again, and others diminish until they wholly disappeared. Finding it very difficult to measure the lucid part any longer, I observed again in the larger telescope, looking out for the total immersion.

"After viewing the sun's limb about a minute, I found almost the whole of it thus broken or separated into drops, a small part only in the middle remaining connected. Plate I, Figure VII. This appearance remained about a minute, when one of my assistants, who was looking at the sun with his naked eye, observed that the light was increasing."

He then resumed his proper task of making measures of the width of the increasing crescent until the end of the eclipse.

Other phenomena observed are as follows :

"From the beginning of the eclipse unto the time of the greatest obscuration, the *colour* and *appearance* of the sky was gradually changing from an azure blue to a more dark or dusky colour, until it bore the appearance and gloom of night."

"The degree of darkness was greater than was to be expected, considering the sun was not wholly obscured. *Venus* appeared in the west; *Jupiter* was seen near the sun; *Lucida* near the zenith, and *Aridef* in the north-east near the horizon, appeared very bright."

[There seems to be some mistake here, both the stars mentioned were in the north-east, while the star near the zenith was *Arcturus*, "Bonus dormitat Homerus," as the learned professor himself might have said.]

"Several others of the fixt stars were also seen whose situations were not particularly noted. Objects at a small distance appeared confused, and we were obliged to make use of candles to count our clock. But

as soon as the greatest obscuration was past, it was universally remarked that the increase of the light was much more rapid than that of the darkness had been.

"As the darkness increased a *chill* and *dampness* were very sensibly felt. To ascertain the quantity of *dew* that fell on a square foot during the eclipse, we cut two pieces of very fine soft paper exactly twelve inches square. Having weighed them in a nice balance, we placed them on an horizontal board in the open air. Just after the greatest obscuration we weighed one of them again, and found its weight was increased by the *dew* that had fallen upon it, four and one-half grains *Troy*. At the end of the eclipse we took up the other, and found its weight increased by the *dew* that lay upon it, but 3 grains; 1-1/2 grains being evaporated as the light and heat of the sun increased. By a similar experiment, the quantity of *dew* that fell upon a square foot the night before was found to be 6-1/2 grains; the night after the eclipse, 7 grains. Thus, in 1 hour and 19 minutes, when the light and heat of the sun were rapidly decreasing, there fell two-thirds as much *dew* as fell the night before, or the night after the eclipse."

Observations of the Fahrenheit thermometer showed a fall from 58° at the beginning of the eclipse to 48° at the greatest obscuration.

"To this we may add, so unusual a darkness, dampness and chill, in the midst of the day, seemed to spread a general amazement among all sorts of animals. Nor could we ourselves observe such unusual phenomena without some disagreeable feelings."

The account closes thus: "The longitude of the place of our observation agrees very well with what we had supposed in our calculations. But the latitude is near half a degree less than what the map of that part of the country had let us to expect. On this account our situation, instead of falling within the limits of total darkness proved to be very near the southern extremity."

I hope it will not tire you if I read from the account of James Winthrop, preserved in the archives of the Academy, but, so far as I know, never printed:

An Account of the Proceedings of the Company sent by the General Court of Massachusetts to observe the Solar Eclipse at Penobscot on 27 Oct. 1780; By James Winthrop.

On Monday 9th Oct. 1780, We sailed from Boston in the sloop Lincoln-Galley, a vessel belonging to the Government. The Company consisted of ten persons besides passengers & marines. Stormy weather prevented our arrival at Camden till the fourteenth. Having obtained leave from Genl Wadsworth, commander of the Massachusetts

Forces in that department, a flag was sent from thence on the fifteenth to the British Commanders at Penobscot, with letters from the Reverend Professor Williams, desiring permission to enter their harbor immediately, as our business was solely to promote the interest of Science, which is the common interest of all mankind. Mr Vernon took charge of the letters. On the 16th he returned with the answers of Lieut. Col. Campbell & Captain Mowatt. They both permitted us to come up the Bay immediately, & to anchor our Vessel in Williams' cove on the east side of Long Island, about three leagues from the British Fort. From thence we were directed to go in our boat to the Albany, which lay near the fort, before we should land. Capt. Mowatt very politely offered us every assistance in his power towards promoting the business we had in view. Colonel Campbell received us with evident reluctance. His strict prohibitions of all communication with the Inhabitants put it out of our power to procure the smallest articles of refreshment, or any building to secure our apparatus. In consequence of these orders we went up the Bay to Williams' cove on the 17th & on the next day in our boat to the Albany. We found no convenient place for our observations about the harbor. Being uncertain of our Longitude and Latitude, & surrounded by almost perpetual fogs, We determined to tarry at Long Island. With permission we took up part of an house & barn which were made to answer our purpose. On the 19th & 20th we set up our clock & other instruments. Till the 24th the weather was so thick, that we had no opportunity to make any observations, either for regulating the clock or ascertaining the Latitude. The Variation we observed daily by means of a meridian drawn the first day of our being ashore. All our observations made it 11°, 55′ West. In the year 1761 Doctor Winthrop observed the Variation to be 8° West at Fort Pownal about twelve miles N. E. from our place of Observation. Whence it appears, that contrary to the common opinion the Variation has been increasing in the eastern parts of this State for several years past.

"The 24th, 25th, & 26th were spent in regulating the clock, & determining the latitude. The latitude appears from the mean of several observations of the Sun & Fixed Stars to be 44°, 17′, 8″, which is not so far northerly as the maps represent.

"On the Twenty seventh the weather was perfectly fine. In the morning we took several altitudes. A little before eleven o'clock the observers took their places: But as a compleat account of their Observations will be presented by Mr Professor Williams, to mention them particularly here would be needless. I shall confine myself to physical appearances; & content myself with remarking that the eclipse was

greater than we had reason to expect at that place. As the Eclipse increased Fahrenheit's Thermometer, which at the beginning stood at 58, gradually fell to 48½ where it stood at the time of the greatest obscuration. The weather was sensibly colder though the change was gradual. Our Prospect became confined, & distant objects were lost while those about us assumed a gloomy appearance. The Sky, particularly at the northeast, appeared as if charged with a thick fog. The Darkness was so great, that a lanthorn was necessary in counting the Clock; yet we had light enough abroad to distinguish countenances without any difficulty, & to write down our observations. Shades were better defined than they ever are by moon-light; & the Sun, even at the greatest obscuration, shone with such dazzling brightness, that those of the company, who looked without a colored glass, could hardly perceive the Eclipse.

"Venus was seen clearly by the whole company shining with a vivid light. Several other Stars were seen, among which were Lucida Lyrâ & Aridef. The part of the Sun which remained uneclipsed was not more than one eightieth part of his diameter, & one eighth of his Circumference. The upper cusp was ragged & the lower one rounded. At the upper point appeared two drops as bright as Stars of the first magnitude. At the end of the eclipse the Thermometer had risen to 58, where it was when the eclipse begun. The dew which fell on a sheet of paper twelve inches square was found immediately after the middle of the Eclipse to be 4½ grains. On another sheet at the end of the Eclipse it was 3 grains. The preceding night it was 6½, & the night following 7 grains. On the 28th we packed our Instruments, & sent them aboard the Vessel. The next day we set sail, & on the 10th of November arrived in Boston."

It is evident from what I have read to you that the Academy was fortunate in the personnel of its party, — it was well equipped and prepared to observe any new and unexpected phenomena which might occur. We can only guess what they might have seen and reported if they had found a more suitable place of observation than was permitted by the military conditions imposed on them. That they would have found by their first day's observations for latitude that it was advisable to move further to the northeast, perhaps to the fort itself, seems probable, and in that case there would have been an unusually efficient group of men upon the spot.

To say nothing of their elders, the general character of the six undergraduates who accompanied the party is shown by their later lives. Two were members of the Academy, two were members of Congress, and one a Justice of the Supreme Court of New Hampshire. The graduate, Mr. Fortesque Vernon, died in 1790.

May I add that it is a peculiar gratification to myself, and will certainly be to some others present, that we have a personal acquaintance with at least two of the instruments which were used on this adventure.

In the collections of the Department of Physics at Cambridge is the two-foot reflector used by Professor Williams; on it is a silver plate bearing the arms of Pepperell and Sparhawk, — both good examples of canting heraldry. It was the gift of Sir William Pepperell after the destruction of the collection of Philosophical Instruments in Harvard Hall in 1764.

It is furnished with a divided object glass micrometer by Dollond, the precursor of the modern heliometer. A similar micrometer, the one with which Professor Williams made his measurements, was attached to the smaller reflector of one foot focus. This little instrument now has a place in the Faculty Room at Cambridge, just under the portrait of John Winthrop, in which it is faithfully depicted as an artistic accessory.

Gentlemen, it is almost no exaggeration to say that to-day, at our thousandth meeting, we have a thousandfold advantage over the founders. In the interval — back of us, before them — lies the century wonderful of science. But theirs were no small beginnings. I congratulate the Academy on its first research.

The last toast proposed was "The Millenium," responded to by Professor George L. Kittredge.

The celebration closed with thanks to Dr. Louis Bell and to Professor W. M. Davis for their inception of the quaint celebration of the one thousandth meeting, and for their success in making it a memorable one.

The following papers were presented by title: —

"On the Internal Resistance of the Lead Accumulation." By H. W. Morse and L. W. Sargent. Presented by John Trowbridge.

"The Wave Potential of a Circular Line of Sources." By A. G. Webster.

"Division of Labor among Ants." By Edith N. Buckingham. Presented by E. L. Mark.

"A New Method for the Study of Elastic Hysteresis." By A. G. Webster and T. L. Porter.

"The Action of Metals on Ketoric Chlorides of the Aromatic Series." By J. F. Norris.

One thousand and second Meeting.

JANUARY 11, 1911. — STATED MEETING.

The Academy met in its Hall.

The PRESIDENT in the chair.

There were thirty-eight Fellows present.

The Corresponding Secretary presented the following: — a letter from Professor W. G. Farlow, representative of the Academy at the Third International Botanical Congress, enclosing a printed report of the Congress; a notice of the death of Angelo Mosso, from the Reale Accademia delle Scienze, Torino; a letter from Mr. Loammi F. Baldwin, of Woburn, notifying the Academy of the bequest in the will of Mrs. Catherine Rumford (Baldwin) Griffith, of mementos of Count Rumford; the felicitations of the new year, from the Museo nacional de Arqueologia, Historia y Etnologia, Mexico; a circular letter from the Nobel committee of the Svenska Akademien, requesting the distribution of some enclosed circulars regarding the competition for the Nobel Prize in Literature.

The President read the following letter from the sons of the late Professor Agassiz: —

14 ASHBURTON PLACE, BOSTON, MASS.,
January 7, 1911.

PRESIDENT AND MEMBERS OF THE AMERICAN ACADEMY.

Gentlemen, — From a letter of our father's to Professor Trowbridge, dated October 16th, 1909, and published in Vol. 45, No. 21, of your Proceedings, it is evident that Mr. Agassiz did not intend to endow the building that he proposed to give to the Academy.

We therefore take pleasure in making the following proposal: Should the Academy care to devote the $50,000 (bequeathed to the Academy unconditionally by Mr. Agassiz) toward the construction of the building he proposed to give them, we on our part will give No. 26 Newbury Street clear of all mortgages, and pay the balance of the cost of construction, provided this sum does not exceed $30,000. (You will notice by the enclosed letter from the Architects that the estimated cost of the building is approximately $74,000.) We will pay the Architect's fee, and give the sum of $9,000 for furnishing the building.

As our interest in this matter is to carry out Mr. Agassiz's wishes as nearly as we can interpret them, we should like to have it understood

that the Academy, in case it favors our proposal, will make no changes from the plan which we hand you herewith without consulting us.

As we should regret to feel that we had induced the Academy to adopt a measure that was opposed by any considerable minority of its members, we would like, in case the Academy accepts our offer, the assurance that such a course meets with the approval of at least three-quarters of its active members.

We trust that the members of the Academy will give themselves ample time to consider carefully how they expect to meet the additional expenses of the maintenance of a larger building; and that they will also consider whether they would not prefer to have the use of a fund of $50,000 rather than the proposed building.

We enclose plan of the building and short description of the specifications.

Respectfully yours,

(signed) G. R. Agassiz,
Max. Agassiz,
R. L. Agassiz.

On the motion of Dr. Ernst it was

Voted, I. That the thanks of the Academy be returned to the sons of Professor Agassiz for the letter transmitted by the President.

II. That the letter be referred to the Committee on Policy for action in connection with the circular of information and inquiry to be sent out by it.

The President made a brief statement of the probable annual expense of running the proposed new building; and also a statement of the number of Resident Fellows at stated periods during the last one hundred years, showing that the Resident Fellowship had not increased for forty years, whereas there were a great many who were eligible to Fellowship in the Academy.

The following gentlemen were elected members of the Academy: —

Richard Cockburn Maclaurin, of Boston, to be a Resident Fellow in Class I., Section 2.

William Curtis Farabee, of Cambridge, to be a Resident Fellow in Class III., Section 2.

Alfred Marston Tozzer, of Cambridge, to be a Resident Fellow in Class III., Section 2.

Albert Matthews, of Boston, to be a Resident Fellow in Class III., Section 4.

On motion of the Recording Secretary, it was

Voted, To appropriate the following sums from the income of the General Fund: —

For Expenses of meetings	$100
For Treasurer's office	25
For General Expenses, at the discretion of the President	50

The following letter to the President was read: —

PROF. JOHN TROWBRIDGE.

Dear Sir, — At a meeting of the Committee of the University Museum of Harvard University, held 4 January, 1911, it was Voted, To invite the American Academy of Arts and Sciences to hold a Meeting in the spring of 1911 in the University Museum.

Yours truly,

SAMUEL HENSHAW, for the Committee.

On the motion of W. M. Davis, it was

Voted, That a committee be appointed to plan and carry out the meeting in Cambridge.

The President appointed Messrs. Wolff, Jeffrey, Mark, Henshaw, Putnam, and W. M. Davis a committee on the Cambridge meeting.

The following communication was given: —

"An Investigation of the Cartago Earthquake in Costa Rica," by Professor T. A. Jaggar, Jr.

The following papers were presented by title: —

"A Revision of the Atomic Weight of Iron. Third paper. — The Analysis of Ferrous Bromide." By G. P. Baxter, Thorbergur Thorvaldson, and Victor Cobb.

"A Revision of the Atomic Weight of Iron. Fourth paper. — The Atomic Weight of Meteoric Iron." By G. P. Baxter and Thorbergur Thorvaldson.

"Buddhaghosa's Way of Purity analysed: first third, Morality." By C. R. Lanman.

On motion of the Recording Secretary it was

Voted, To meet on adjournment on the second Wednesday in February.

One thousand and third Meeting.

FEBRUARY 8, 1911. — ADJOURNED STATED MEETING.

The PRESIDENT in the chair.

There were thirty-six Fellows present.

In the absence of the Corresponding Secretary, the President read the following letters and circulars: — letters accepting Fellowship from W. C. Farabee, A. M. Tozzer, Albert Matthews, R. C. Maclaurin; a circular from the Royal Frederick University of Christiania, inviting the Academy to send a delegate to its one hundredth anniversary celebration to be held September 5–6, 1911; a circular of the Fourth International Congress of Philosophy to be held at Bologna, April 6–11, 1911; a circular from the Boston 1915 Committee, asking a delegate to the first annual meeting of the Education Conference to be held March 16, 1911; a card of invitation to the President to attend a meeting in memory of Henry Charles Lea, at Philadelphia, January 20th.

The President announced the following deaths: — Samuel H. Butcher, Foreign Honorary Member in Class III., Section 4; Leonard P. Kinnicutt, Resident Fellow in Class I., Section 3, — a member of the Warren Committee since its formation in 1893, and chairman of that Committee since 1902.

The President reported that the Committee on Policy had voted against allowing any member to be enrolled in two different Sections of the Academy at the same time, and that the Council accepted that report.

The President read the following: —

The Committee on Policy submits the following recommendations as its report, and will move their adoption.

1. To accept the offer of the Agassiz heirs, whereby we should secure a dignified and comfortable home, with the probability of increased activity and wider influence, the methods of raising the funds needed for the increased cost of maintenance to be left for future consideration.

Note 1. In reply to a recent circular 133 Fellows voted in favor of the above recommendation, 10 voted against it, 56 did not vote.

Note 2. A committee on endowment has been appointed, from which a preliminary report is expected.

2. To amend the statutes in accordance with the bill now before the Legislature, then to increase the Massachusetts membership by 20 or 25 a year until we have perhaps 300 such members; and thereafter to increase membership as the Academy shall then determine.

3. To amend the statutes so that we may gradually increase the American membership outside of Massachusetts to such a number — for example, 300 or 400 — as shall justify our name: "The American Academy of Arts and Sciences"; and thus in some measure return to the original intention of the Academy.

4. To place all American members in one list, all to have the right of attending meetings, presenting papers, and taking part in discussions. All Massachusetts members to pay an annual fee, and to have the further rights of voting on the affairs of the Academy, publishing in the publications of the Academy and receiving the publications if desired. American members residing outside of Massachusetts also to have these additional rights on payment of corresponding fees. All American members to be called Fellows, and their names to be published in one list, subdivided into Classes and Sections as at present, but without indicating which are paying and which non-paying members.

5. That the functions of the Council be enlarged, in order to give it supervision over all the affairs of the Academy, not otherwise specified by the statutes.

6. That a committee of five, including the President and the Recording Secretary, be appointed to take charge of meetings.

Note. Recommendations 5 and 6 were reported to the Academy November 9th, 1910.

If the above recommendations are adopted by the Academy, proposed alterations of the statutes will be submitted, for reference to a committee.

The President reported that the Committee on endowment — Messrs. C. P. Bowditch, E. C. Clarke, and the President — had been promised four thousand dollars without effort on the part of the Committee, and he saw no reason why an endowment of fifty thousand dollars might not be raised.

On motion of W. M. Davis, seconded by A. G. Webster, it was

Voted, To adopt the first recommendation of the Committee on Policy, as follows: —

"Accept the offer of the Agassiz heirs, whereby we secure a dignified and comfortable home, with the probability of increased

activity and wider influence, the methods of raising the funds needed for the increased cost of maintenance to be left for future consideration."

On motion of W. R. Livermore it was

Voted, To adopt the second recommendation of the Committee, as follows: —

"Amend the statutes in accordance with the bill now before the Legislature, then to increase the Massachusetts membership by 20 or 25 a year until we have perhaps 300 such members; and thereafter to increase membership as the Academy shall then determine."

On motion of Louis Bell, it was

Voted, That the fourth recommendation be laid on the table.

On motion of A. G. Webster it was

Voted, to adopt the fifth recommendation, as follows: —

"That the functions of the Council be enlarged, in order to give it supervision over all affairs of the Academy, not otherwise specified by the Statutes."

On motion of A. G. Webster it was

Voted, To adopt the sixth recommendation, as follows: —

"That a committee of five, including the President and the Recording Secretary, be appointed to take charge of meetings."

On motion of A. G. Webster it was

Voted, That the third recommendation be laid on the table.

Professor Davis presented proposed alterations of the Statutes to accord with the recommendations of the Committee on Policy just adopted, and moved that they be referred to a Committee.

The President referred the proposed alteration of the Statutes to a Committee consisting of W. M. Davis and H. H. Edes.

The meeting then adjourned to the Reception room where the following paper was given by Professor Kuno Francke: — "The Historical Aspect of Mediaeval German Mysticism."

The following papers were presented by title: —

"The Opacity of Certain Glasses to the Ultra Violet." By Louis Bell.

"On the Electromagnetic and Thermomagnetic Transverse and Longitudinal Effects in Soft Iron." By Edwin H. Hall and L. L. Campbell.

"Notes on the Electrical Conductivity of Argentic Sulphide." By Hammond V. Hayes.

"Investigation of Temperature Errors caused by the Protection Tube in Cooling-Curve Measurements." By Harvey C. Hayes. Presented by J. Trowbridge.

"Determination of the Altitudes of Aeroplanes." By Robert W. Willson.

One thousand and fourth Meeting.

MARCH 8, 1911. — STATED MEETING.

The PRESIDENT in the chair.

There were thirty-seven Fellows present.

The Corresponding Secretary read a letter from Mr. F. J. Stimson, resigning Fellowship; also the preliminary announcement of the Eighth International Congress of Applied Chemistry, to take place in Washington and New York September 4–13, 1912.

The Chair announced the death of Judge Francis C. Lowell, Resident Fellow in Class III., Section 1.

The report of the Committee on the amendments of the Statutes was read and accepted, and the amendments were adopted, as follows:

The first three printed lines of Chapter I., Article 2 are amended so as to read:

"2. The number of Resident Fellows residing in the Commonwealth of Massachusetts shall not exceed four hundred, of whom there shall not be more than one hundred and fifty in any one of the three classes."

The last five printed lines of Chapter II., Article 2 are amended so as to read:

"It shall be the duty of this Council to exercise a discreet supervision over all nominations and elections, and in general to supervise all the affairs of the Academy, not explicitly reserved to the Academy as a whole, or intrusted to special Committees by these statutes. With the consent of the Fellow interested, the Council shall have the power to make transfers between the several sections of the same Class, reporting their action to the Academy."

The last paragraph of Chapter II., Article 3, and the whole of Article 4, are amended so as to read:

"At the Annual Meeting, the Council shall submit to the Academy for its action, a report recommending the appropriations which in the opinion of the Council should be made for the various purposes of the Academy. Special appropriations may be made in any stated meeting of the Academy on the recommendation of the Council.

"4. If any office shall become vacant during the year, the vacancy shall be filled by the Council for the unexpired term."

Article 5 of Chapter III. is repealed.

Chapter V., Article 7 is amended so as to read as follows:

"7. The House Committee to consist of three Fellows. This Committee shall have charge of all expenses connected with the House, including the general expenses of the Academy not specifically assigned to other Committees, but not including the expenses of meetings. This Committee shall report to the Council in March in each year on the appropriations needed for the coming year. All bills incurred by this Committee within the limits of the appropriations made by the Academy shall be approved by the Chairman of the House Committee."

A new Article, No. 8, is added, as follows:

"8. The Committee on Meetings, to consist of the President, the Recording Secretary and three Fellows. This Committee shall have charge of plans for meetings of the Academy. It shall report to the Council in March in each year on the appropriations needed for the coming year. All bills incurred by this Committee within the limits of the appropriations made by the Academy shall be approved by the Chairman of the Committee on Meetings."

The present Article 8 becomes Article 9.

The present Article 9 becomes Article 10.

Chapter VI., Article 1 is amended so as to read:

"1. The Corresponding Secretary shall conduct the correspondence of the Academy, recording or making an entry of all letters written in its name, and preserving on file all letters which are received; and at each meeting of the Council he shall present the letters which have been addressed to the Academy since the last meeting, and at the next meeting of the Academy he shall present such of these letters as the Council may determine. Under the direction of the Council, he shall keep a list of the Resident Fellows, Associate Fellows, and Foreign Honorary Members, arranged in their Classes and in Sections in respect to the special sciences in which they are severally proficient; and he shall act as secretary to the Council."

Standing Vote 10 is amended so as to read:

"10. No report of any paper presented at a meeting of the Academy shall be published by any member without the consent of the author,

and no report shall in any case be published by any member in a newspaper as an account of the proceedings of the Academy, without the consent and approval of the Council previously given."

It was

Voted, to adopt the third and fourth recommendations of the Committee on Policy, read at the meeting of February 8th, with the addition of the words "(United States)" after the word American in line one of Recommendations 4, as follows:

"To amend the statutes so that we may gradually increase the American membership outside of Massachusetts to such a number — for example, 300 or 400 — as shall justify our name: 'The American Academy of Arts and Sciences;' and thus in some measure return to the original intention of the Academy."

"To place all American (United States) members in one list, all to have the right of attending meetings, presenting papers, and taking part in discussions. All Massachusetts members to pay an annual fee, and to have the further rights of voting on the affairs of the Academy, publishing in the publications of the Academy, and receiving the publications if desired. American members residing outside of Massachusetts also to have these additional rights on payment of corresponding fees. All American members to be called Fellows, and their names to be published in one list, subdivided into Classes and Sections as at present, but without indicating which are paying and which non-paying members."

The Corresponding Secretary presented proposed alterations of the Statutes to accord with the recommendations of the Committee on Policy just adopted, together with other alterations recommended by the Council, and moved that they be referred to a Committee.

The President referred the proposed alterations of the Statutes to a Committee consisting of H. H. Edes and W. M. Davis.[1]

Dr. Ernst said that as the adoption by the Academy of the several recommendations of the Committee on Policy necessitated so many alterations in the Statutes, other changes might, in consequence, suggest themselves to the Committee; and he

[1] Professor Davis, having been called to Europe soon after his appointment, resigned from the Committee, whereupon the President appointed Professor Elihu Thomson and Dr. Henry Lefavour to serve with Mr. Edes.

expressed the hope that it would feel warranted in incorporating in its report such further changes as it may deem expedient. Whereupon it was

Voted, That the Committee be authorized and requested to act in accordance with Dr. Ernst's suggestion.

It was

Voted, To appropriate from the income of the Publication Fund, five hundred (500) dollars for use of the Publication Committee during the present year.

It was also

Voted, To appropriate from the income of the General Fund, twenty (20) dollars for General expenses.

William Wallace Campbell, of Mt. Hamilton, Cal., was elected an Associate Fellow in Class I., Section 1 (Mathematics and Astronomy).

The President reported that the Charter of the Academy had been further amended by the Massachusetts Legislature as follows:

[Chapter 47.]

COMMONWEALTH OF MASSACHUSETTS.

In the year One Thousand Nine Hundred and Eleven.

An Act Relative to the American Academy of Arts and Sciences.

Be it enacted by the Senate and House of Representatives in General Court assembled and by the authority of the same, as follows: —

SECTION 1. Section four of chapter forty-six of the acts of the year seventeen hundred and seventy-nine, as amended by section one of chapter one hundred and twenty-nine of the acts of the year nineteen hundred and ten, is hereby further amended by striking out the word "three," in the last line, and inserting in place thereof the word: — four, — so as to read as follows: — SECTION 4. That the fellows of the said academy may from time to time elect such persons to be fellows thereof as they shall judge proper; and that they shall have full power and authority from time to time to suspend, expel or disfranchise any fellow of the said academy who shall by his conduct render himself unworthy of a place in that body, in the judgment of the academy; and also to settle and establish the rules, forms and conditions of election, suspension, expulsion and disfranchisement: provided, that the number of the said academy, who are inhabitants of this state,

shall not at any one time be more than four hundred nor less than forty.

SECTION 2. Section six of said chapter forty-six, as amended by section two of said chapter one hundred and twenty-nine, is hereby further amended by striking out the word "one," in the seventh line, and inserting in place thereof the word: — two, — and by striking out the word "three," in the eighth line, and inserting in place thereof the word: — five, — so as to read as follows: — SECTION 6. That the fellows of the said academy may, and shall forever hereafter be deemed capable in the law of having, holding and taking, in fee-simple or any less estate, by gift, grant, devise or otherwise, any lands, tenements or other estate, real and personal: provided, that the said real estate shall not exceed in value the sum of two hundred thousand dollars, and the said personal estate shall not exceed in value the sum of five hundred thousand dollars; all the sums mentioned in the preceding section of this act to be valued in silver at the rate of six shillings and eight pence by the ounce: and the annual interest and income of the said real and personal estate, together with the fines and penalties aforesaid, shall be appropriated for premiums, to encourage improvements and discoveries in agriculture, arts and manufactures, or for other purposes consistent with the end and design of the institution of the said academy, as the fellows thereof shall determine.

SECTION 3. This act shall take effect upon its passage.

HOUSE OF REPRESENTATIVES, February 14, 1911.

Passed to be enacted. JOSEPH WALKER, *Speaker*.

IN SENATE, February 15, 1911.

Passed to be enacted. ALLEN T. TREADWAY, *President*.

February 17, 1911.

Approved. EUGENE N. FOSS.

Office of the Secretary,

BOSTON, March 2, 1911.

A true copy.

Witness the Great Seal of the Commonwealth.

WM. M. OLIN,

[Seal.] *Secretary of the Commonwealth.*

The President appointed the following gentlemen a Nominating Committee: —

Harry M. Goodwin, of Class I.

Charles S. Minot, of Class II. (Chairman)

George F. Moore, of Class III.

It was

Voted, To meet on adjournment April 12th.

The following communication was given by Dr. D. G. Lyon: "Harvard Excavations at Samaria in 1910," illustrated by lantern slides.

The following paper was presented by title: —

Contributions from the Gray Herbarium of Harvard University, new series, No. XXXIX. I. On the Classification of certain Eupatorieae; II. Revision of the Genus Barroetia; III. On some hitherto undescribed or misplaced Compositae. By B. L. Robinson.

One thousand and fifth Meeting.

Adjourned Stated Meeting. — April 12, 1911.

The Academy met in the Geological Lecture Room of the University Museum, Cambridge, at the invitation of the Committee of the Museum.

The President in the chair.

There were fifty-five Fellows, and forty-three guests present.

The following letters and circulars were presented: — from the Verein für Naturkunde, Cassel, an invitation to the celebration of its seventy-fifth anniversary; from the Committee of the American Year Book Corporation, asking that a representative of the Academy attend its meeting, March 25th, and asking for authority to add the name of the representative of the Academy to the Corporation; from the tenth International Congress of Geography to be held at Rome, Oct. 15–22, 1911 (Circular No. 2).

The Chair announced the death of Henry Pickering Bowditch, Resident Fellow in Class II., Section 3; and of Samuel Franklin Emmons, Associate Fellow in Class II., Section 1.

It was

Voted, To transfer the money now appropriated from the income of the Rumford Fund for Books and binding, to that of Periodicals and binding.

The chairman of the Rumford Committee stated that the Rumford Premium was granted to Mr. Charles Gordon Curtis

for his "improvements in the utilization of heat as work in the steam-turbine."

The President presented the medals to Mr. Curtis.

Mr. Curtis in receiving the medals addressed the Academy on the "Development of the Steam Turbine in the United States."

Professor George A. Reisner gave an illustrated account of the Archaeological Survey of Lower Nubia.

The following paper was presented by title:

"The Nature of Volcanic Action." By Reginald A. Daly.

One thousand and sixth Meeting.

MAY 10, 1911. — ANNUAL MEETING.

The PRESIDENT in the chair.

Thirty-six Fellows present.

The Chair announced the death of Thomas Wentworth Higginson, Resident Fellow in Class III., Section 4; of Charles Otis Whitman, Associate Fellow in Class II., Section 3; and of J. H. van't Hoff, Foreign Honorary Member in Class I., Section 3.

The Corresponding Secretary read the following letter and circulars: — from Lucien Carr, resigning Fellowship; from the Committee of the International Congress of Orientalists, inviting delegates to the 16th Session to be held at Athens, April 7th–14th, 1912; from the Committee of the first Universal Race Congress, to be held in London, July 26th–29th, 1911.

The following report of the Council was read: —

Since the last report of the Council eighteen deaths have been reported: — five Resident Fellows, — Robert Amory, Leonard Parker Kinnicutt, Francis Cabot Lowell, Henry Pickering Bowditch, Thomas Wentworth Higginson; seven Associate Fellows, — Cyrus Ballou Comstock, William Price Craighill, William Wirt Howe, Melville Weston Fuller, George Park Fisher, Samuel Franklin Emmons, Charles Otis Whitman; six Foreign Honorary Members, — Friedrich von Recklinghausen, Samuel Henry Butcher, William Huggins, Robert Koch, Maurice Levy, Jacobus Henricus van't Hoff.

Two Resident Fellows have resigned.

New members elected are: — Resident Fellows, six; Associate Fellows, one.

The roll of the Academy now includes 194 Resident Fellows, 76 Associate Fellows, and 55 Foreign Honorary Members.

The annual report of the Treasurer was read, of which the following is an abstract: —

GENERAL FUND.

Receipts.

Balance, May 1, 1910	$975.63	
Investments	1,799.40	
Assessments	1,860.00	
Admission fees	90.00	
Sale of chairs	35.00	$4,760.03

Expenditures.

Expense of House	$944.98	
Expense of Library	2,438.71	
Expense of Meetings	259.59	
Treasurer	164.31	
Insurance	48.00	
Moving	100.29	
Rent, 711 Boylston St.	18.75	
General expenses of Society	174.21	
Income transferred to principal	173.05	$4,321.89
Balance, May 1, 1911		438.14
		$4,760.03

RUMFORD FUND.

Receipts.

Balance, May 1, 1910	$1,359.31	
Investments	3,008.28	$4,367.59

Expenditures.

Research	$1,650.00	
Books, periodicals and binding	272.66	
Publication	398.92	
Medals	400.00	
Sundries	3.50	
Income transferred to principal	144.41	$2,869.49
Balance May 1, 1911		1,498.10
		$4,367.59

C. M. WARREN FUND.

Receipts.

Balance, May 1, 1910	$783.48	
Investments	385.63	$1,169.11

Expenditures.

Research	$200.00	
Sundries	4.90	
Income transferred to principal	16.49	
Charged to reduce premium on bonds	50.00	$271.39
Balance, May 1, 1911		897.72
		$1,169.11

PUBLICATION FUND.

Receipts.

Balance, May 1, 1910	$1,321.95	
Appleton Fund investments	664.06	
Centennial Fund investments	2,331.67	
Sale of publications	332.78	$4,650.46

Expenditures.

Publication	$3,370.43	
Sundries	67.50	
Income transferred to principal	146.35	$3,584.28
Balance, May 1, 1911		1,066.18
		$4,650.46

The following reports were also presented: —

REPORT OF THE LIBRARIAN.

During the construction of the new building, the Academy has obtained Room 5, of the office-building 711 Boylston Street, as temporary quarters for the Assistant Librarian.

In March the unbound periodicals, the pamphlets, and all the stock of Proceedings and Memoirs which was in the basement of 28 Newbury Street were safely and expeditiously removed under the efficient supervision of the Assistant Librarian and Charles E. Wilder, who has been an assistant in the Library out of school and college hours since 1904.

The number of volumes added to the shelves during the past year is three hundred and twenty-seven, making thirty-one thousand, three

hundred and forty-three. The number of volumes added includes two hundred and seventy-seven received by gift and exchange, thirty-six purchased by the General Fund, and fourteen by the Rumford Fund.

Eighty-five books have been borrowed from the library up to the time the stack building was closed, March 25th.

The expenses charged to the library are as follows : — Miscellaneous, $371.95 (which includes $104.62 for cataloguing) ; Binding, $539.55 General, and $69.55 Rumford, Funds ; Periodical subscriptions $483.71 General, and $164.34 Rumford, Funds, as the cost of subscriptions and binding.

The appropriation of $50 from the income of the Rumford Fund plus $68.17, the unexpended balance from last year for Books and binding, was transferred to the account of the appropriation for Periodicals and binding.

A. Lawrence Rotch, *Librarian.*

May 10, 1911.

Report of the Rumford Committee.

During the past year the following persons have received grants of the sums specified in aid of researches on light or heat : —

October 12, 1910. Dr. P. W. Bridgman, of the Jefferson Physical Laboratory, for the continuance of his research on the thermal and optical properties of bodies under extreme pressures, additional, ... $400

Professor Charles L. Norton, of the Massachusetts Institute of Technology, for his researches on thermal insulation . . . 400

January 11, 1911. Professor Joel Stebbins, of the University of Illinois, for the continuance of his researches with the selenium photometer, additional, ... 200

Professor M. A. Rosanoff, of Clark University, for his investigations on the fractional distillation of binary mixtures, additional, ... 300

February 8, 1911. Dr. Daniel F. Comstock, of the Massachusetts Institute of Technology, for his research on the possible effect of the motion of the source on the velocity of light . 100

Professor Gilbert N. Lewis, of the Massachusetts Institute of Technology, for his research on the free energy changes in chemical reactions 150

Professor Robert W. Wood, of the Johns Hopkins University, for his researches on the optical properties of vapors 150

Since the last annual meeting of the Academy, the following papers

have been published in the Proceedings at the expense of the Rumford Fund :

Vol. 46, No. 4. "Note on Kirchoff's Law." By G. C. Evans.

Vol. 46, No. 11. "On the Equilibrium of the System consisting of Calcium Carbide, Calcium Cyanamide, Carbon, and Nitrogen." By M. DeK. Thompson and R. H. Lombard.

Vol. 46, No. 19. "A Method for Determining Heat of Evaporation as applied to Water." By T. W. Richards and J. H. Mathews.

Vol. 46, No. 23. "On the Electromagnetic and the Thermomagnetic Transverse and Longitudinal Effects in Soft Iron." By E. H. Hall and L. L. Campbell.

Vol. 46, No. 24. "On the Opacity of Certain Glasses for the Ultra-Violet." By L. Bell.

On October 12, it was voted that the Chairman of the Committee be requested to bring up to date the pamphlet concerning the Rumford Fund, published by the Academy in 1905.

The endeavors of the Committee to procure fac-simile copies of the inscriptions upon the reverse of the Rumford Medals awarded prior to 1899, in order that replicas in bronze may be made, have been successful. All but one of the medals have been located and photographs or plaster casts of these are gradually being secured. Since the date mentioned, a bronze replica of each medal awarded has been made at the same time as those to be presented.

Reports of progress in their respective researches which have been aided from the Rumford Fund have been received from Messrs. P. W. Bridgman, W. W. Campbell, A. L. Clark, D. F. Comstock, W. J. Fisher, E. B. Frost, L. J. Henderson, L. R. Ingersoll, N. A. Kent, F. E. Kester, G. N. Lewis, C. E. Mendenhall, C. L. Norton, J. A. Parkhurst, T. W. Richards, M. A. Rosanoff, F. A. Saunders, J. Stebbins, M. DeK. Thompson, and F. W. Very.

At a meeting of the Committee held on January 11, it was unanimously voted for the first time and at a meeting held on February 8, for the second time, to recommend to the Academy the award of the Rumford Premium to Professor James Mason Crafts, for his researches in high temperature themometry and the exact determination of new fixed points on the thermometric scale.

CHARLES R. CROSS, *Chairman.*

May 10, 1911.

REPORT OF THE C. M. WARREN COMMITTEE.

The C. M. Warren Committee beg to report that during the past year an additional grant of $50 has been made to Dr. J. Elliot Gilpin,

of Johns Hopkins University, for a continuation of his work upon the "Study of the Nature and Source of Petroleum."

Dr. Gilpin has presented a somewhat extended report of work already accomplished, and has outlined his plans for future investigations.

During the year Professor James F. Norris has published his work on the "Structure of Triphenylmethyl," in aid of which a grant of $250 was made by the Warren Committee in 1908.

Reports have been received from Dr. Frederic Bonnet, Jr., Professor W. L. Jennings, and Dr. E. W. Washburn, regarding the progress of researches for which grants have been made from the Warren Fund. None of these researches is as yet sufficiently advanced to permit publication of results.

The Committee has suffered a severe loss during the past year in the removal by death of Dr. Leonard Parker Kinnicutt, for many years one of its most active members, and for the past few years its chairman. The members of the Committee desire to record their sense of appreciation of the efficient service which Dr. Kinnicutt rendered to the Academy, and their sense of personal loss in the termination of his helpful and genial companionship.

H. P. TALBOT, *Chairman.*

May 10, 1911.

REPORT OF THE PUBLICATION COMMITTEE.

Between May 1, 1910, and May 1, 1911, there were published six numbers of Volume XLV. (Nos. 16–21) and twenty-four numbers of Volume XLVI. of the Proceedings. The total publication amounted to 912 + iv pages, with twelve plates. Of these publications, six numbers (No. 18, Vol. XLV., and Nos. 4, 11, 19, 23, and 24 of Vol. XLVI.) have been authorized by the Rumford Committee to be published at the expense of the Rumford Fund.

There was available for use of the Committee on Publication an unexpended balance from last year of $444.49, together with an appropriation of $3,000, and an amount of $23.88 from sales of publications between March 4 and May 1, 1910, and $312.14 from sales between May 1, 1910, and March 3, 1911, — in all, $3,780.51 from the Publication Fund. Bills against this fund to the amount of $3,425.43 have been approved by the Chairman of the Committee, and have been submitted to the Treasurer. This leaves an unexpended balance of $354.68.

Bills aggregating $387.50 incurred in publishing Rumford papers, have been forwarded to the Rumford Committee.

G. W. PIERCE, *Chairman.*

May 10, 1911.

Report of the House Committee.

During the year the house has been occupied as usual, with the exception of the first floor. The building was abandoned on March 25th, and has since been demolished. A temporary office has been secured.

At the annual meeting, May 11, 1910, $1,200 was appropriated for House expenses. In March, 1911, the Meeting-room chairs were sold for $35, making $1,235 for use during the year.

Of this amount $1,182.07 has been expended, leaving a balance of $52.93 toward the expenses of the coming year.

The expenses of the coming year will not be great as heretofore, the largest amount will be that of rent of the present office on Boylston Street — $450, with a few incidentals.

A. G. Webster, *Chairman.*

May 10, 1911.

Financial Report of the Council.

The income for the year 1911–12, as estimated by the Treasurer, is as follows: —

General Fund	Investments	$2,742.13	
	Assessments	1,800.00	$4,542.13
Publication Fund	Appleton Fund	$631.06	
	Centennial Fund	2,334.17	$2,965.23
Rumford Fund	Investments		$2,940.53
Warren Fund	Investments		$336.88

The above estimates, less 5 per cent to be added to the capital, leave an income available for appropriation as follows: —

General Fund	$4,315.03
Publication Fund	2,816.97
Rumford Fund	2,793.50
Warren Fund	320.04

The following appropriations are recommended: —

General Fund.

House expenses	$600	
Library expenses	1,600	
Books, periodicals, and binding	1,200	
Expenses of meetings	200	
Treasurer's office	150	
General expenses	400	$4,150

PUBLICATION FUND.

Publication	$2,500

RUMFORD FUND.

Research	$1,000	
Periodicals, books and binding	250	
Publication	700	
To be used at discretion of Committee	800	$2,750

C. M. WARREN FUND.

Research	$300

On the suggestion of the Assistant Treasurer, the amount recommended for appropriation from the income of the General Fund for Books, periodicals and binding was reduced to $1,000, and the amount recommended for House expenses was raised to $800.

It was then

Voted, To appropriate for the purposes named the following sums : —

From the income of the General Fund	$4,150
From the income of the Publication Fund	2,500
From the income of the Rumford Fund	2,750
From the income of the Warren Fund	300

On motion of the Corresponding Secretary it was

Voted, That the assessment for the ensuing year be ten dollars ($10).

On the recommendation of the Rumford Committee it was

Voted, To award the Rumford Premium to Professor James Mason Crafts, for his researches in high temperature thermometry and the exact determination of fixed points on the thermometric scale.

On the motion of Dr. Bell, it was

Voted, That the Chairman of the House Committee and the Chairman of the Library Committee be constituted, with the President, a Building Committee, to have full power to act for the Academy in all that pertains to the new building, to have authority to add to their number as may seem desirable, and to report progress at each meeting of the Academy. A majority of the members shall constitute a quorum and meetings may be called at any time by any member observing occasion for it.

It was proposed by Professor W. M. Davis, that all meetings of the Academy may be Stated or Business meetings, and that nominations may be either read at a meeting or sent out in print with the notice for the meeting.

It was

Voted, To refer Mr. Davis's proposition to the Committee on the Revision of the Statutes.

The annual election resulted in the choice of the following officers and committees:

JOHN TROWBRIDGE, *President.*
ELIHU THOMSON, *Vice-President for Class I.*
HENRY P. WALCOTT, *Vice-President for Class II.*
JOHN C. GRAY, *Vice-President for Class III.*
EDWIN H. HALL, *Corresponding Secretary.*
WILLIAM WATSON, *Recording Secretary.*
CHARLES P. BOWDITCH, *Treasurer.*
A. LAWRENCE ROTCH, *Librarian.*

Councillors for Three Years.

HARRY W. TYLER, of Class I.
THOMAS A. JAGGAR, JR., of Class II.
ARTHUR FAIRBANKS, of Class III.

Finance Committee.

JOHN TROWBRIDGE,
ELIOT C. CLARKE,
FRANCIS BARTLETT.

Rumford Committee.

CHARLES R. CROSS, ARTHUR G. WEBSTER,
EDWARD C. PICKERING, ELIHU THOMSON,
ERASMUS D. LEAVITT, ARTHUR A. NOYES.
LOUIS BELL.

C. M. Warren Committee.

HENRY P. TALBOT, WILLIAM H. WALKER,
GREGORY P. BAXTER, ARTHUR A. NOYES,
CHARLES R. SANGER, GEORGE D. MOORE,
JAMES F. NORRIS.

The following Standing Committees were chosen: —

Publication Committee.

GEORGE W. PIERCE, of Class I.
WALTER B. CANNON, of Class II.
ALBERT A. HOWARD, of Class III.

Library Committee.

HARRY M. GOODWIN, of Class I.
SAMUEL HENSHAW, of Class II.
HENRY W. HAYNES, of Class III.

Auditing Committee.

HENRY H. EDES, WORTHINGTON C. FORD.

House Committee.

ARTHUR G. WEBSTER, A. LAWRENCE ROTCH,
LOUIS DERR.

Mr. Andrew McFarland Davis exhibited a specimen of the Chinese paper currency of about the date 1375, and explained what is known about the currency of that period.

The following papers were presented by title: —

"Anomalous Magnetization in Iron." By B. O. Peirce.

"The Electrical Inductivities of Certain Poor Conductors." By B. O. Peirce.

"On the von Waltenhofen Effect in Soft Iron Rings." By L. A. Babbitt. Presented by B. O. Peirce.

"Calanoid Copepoda from the Bermuda Islands." C. O. Esterly. Presented by E. L. Mark.

AMERICAN ACADEMY OF ARTS AND SCIENCES.

REPORT OF THE COUNCIL. — PRESENTED MAY 10, 1911.

BIOGRAPHICAL NOTICE.

REPORT OF THE COUNCIL.

Since the last report of the Council eighteen deaths have been reported: — five Resident Fellows, — Robert Amory, Leonard Parker Kinnicutt, Francis Cabot Lowell, Henry Pickering Bowditch, Thomas Wentworth Higginson; seven Associate Fellows, — Cyrus Ballou Comstock, William Price Craighill, William Wirt Howe, Melville Weston Fuller, George Park Fisher, Samuel Franklin Emmons, Charles Otis Whitman; six Foreign Honorary Members, — Friedrich von Recklinghausen, Samuel Henry Butcher, William Huggins, Robert Koch, Maurice Levy, Jacobus Henricus van't Hoff.

HENRY PICKERING BOWDITCH.

At the death of Henry Pickering Bowditch, on March 13, 1911, there passed away a man who, as soldier, scientist, and public-spirited citizen, had led a life of enviable usefulness and permanent achievement. He was born in Boston April 4, 1840, grandson of Nathaniel Bowditch, the distinguished writer on mathematics and navigation; and son of Ingersoll Bowditch, a merchant honored for integrity and generosity. Through his mother, he was descended from the bold and patriotic Col. Timothy Pickering, Secretary of State under Washington.

At the age of seventeen he entered Harvard College, and after four years of study received the A. B. degree in 1861. In the fall of that year he had begun, in the Lawrence Scientific School, the study of chemistry, but then the needs of his country appealed to him so strongly that he volunteered his services for the War. In November he was appointed second lieutenant of the First Massachusetts Cavalry. From January, 1862, when his regiment was sent to the front, until the close of the conflict, he was in active service. He took part in the battle of Secessionville, and his regiment was in the reserve at Fredericksburg. In June, 1862, he was commissioned first lieutenant, and in May, 1863, captain. Thereafter he was in the battles of Aldie, Culpepper, and Rapidan Station; and at New Hope Church, November 27, 1863, he was shot in the right forearm. During the winter of 1863–64 convalescence from his wound kept him from the field. In February,

1864, he was honorably discharged; but almost immediately he joined the service again, as major in the Fifth Massachusetts Cavalry (colored), and with that regiment entered Richmond April 3, 1865.

Major Henry L. Higginson has recorded his memory of Captain Bowditch as he then appeared, — a handsome, refined, and home-bred looking youth, often reserved and even unbending in his manner, but unflagging in his faithfulness and unflinching in his courage.

Except for the end to be sought, however, service in the army was unpleasant to him, and on June 3, 1865, soon after the close of the War, he resigned his command.

In the autumn of 1865, he resumed his studies at the Lawrence Scientific School and came under the inspiring influence of Professor Jeffries Wyman. Although later that fall he entered the Harvard Medical School, he continued to receive the stimulus of Professor Wyman's instruction by pursuing between terms under that famous teacher's direction the subject of comparative anatomy. In 1866 he received the A. M. degree, and in 1868 was graduated from the Medical School.

On receiving his medical degree Dr. Bowditch went abroad to study physiology. He was fortunate in coming into relations with two of the foremost physiologists in the last century, — Claude Bernard, in Paris, and Carl Ludwig, in Leipzig. Bernard did not influence him nearly so much as did Ludwig, who, besides being an enthusiastic investigator, was a most warm-hearted and lovable character. In the Leipzig laboratory at that time and shortly afterwards was a remarkable group of young men, including Mosso, Kronecker, Cyon, Brunton, and Lankester. These men who, as the years passed, took high positions in Switzerland, Italy, France and England, maintained throughout their lives the close friendships established by the delightful days in Leipzig.

Under Ludwig's leadership Dr. Bowditch experienced for the first time the joy and the thrill of scientific search and discovery. As a result he published two papers, one of them, on peculiarities of the activity of cardiac muscle, destined to be famous. In that paper he reported that cardiac muscle differs from other muscle in contracting each time with its full force or not at all — following the "all-or-nothing" law, as it has been called, — and further, that repeated uniform stimulation causes a "treppe" effect, an increasing vigor of contraction, so that the record of the response rises like a stair. The generalization that activity of an organ is favorable to further activity has grown out of this observation on the heart, made forty years ago.

In September, 1871, Dr. Bowditch returned to Boston from Leipzig,

bringing with him, as his wife, Selma Knauth, the daughter of Franz Theodor and Fanny Elizabeth Knauth, at whose home he, with other American students, had been hospitably welcomed. On his return he became Assistant Professor of Physiology in the Harvard Medical School, and in October, 1871, began his service. Previous to that time Oliver Wendell Holmes had given, at the end of his lectures on anatomy, a half-dozen lectures on the functions of the body. In medical circles in Boston at that period there was little appreciation of the ideals of the investigator in scientific medicine; there was only one laboratory and that was the dissecting room. Dr. Bowditch had to create not only his own laboratory, but also his own atmosphere. He secured for his uses two rooms in the attic of the Medical School building on North Grove Street, and fitted them with physiological apparatus. That was the first physiological laboratory, for the use of students, in the United States.

These rooms might perhaps be better designated the first laboratory for experimental medicine established in this country, for every phase of experimental medical work was there represented. Charles S. Minot carried on investigations in general biology, J. Ott in experimental pharmacology, J. C. Warren in experimental pathology, G. Stanley Hall and W. F. Southard in experimental psychology, O. K. Newell in experimental surgery, and W. P. Lombard, J. J. Putnam assisted by William James, C. S. Minot, G. M. Garland, C. H. Williams, J. W. Warren, F. H. Hooper, and F. W. Ellis in physiological researches. The hospitality of the laboratory was unbounded; indeed the first careful work in bacteriology in this country was begun there. With Dr. Bowditch's inspiration every scientific interest of a complete modern medical school was stimulated. From the start the emphasis was on productive scholarship. In the preface to the first collection of papers published from the laboratory the announcement was made that the contributions were presented in a volume, "not from any exaggerated idea of their value and importance, but with the hope that, by calling attention to the facilities offered in the laboratory for original research, a greater number of workers may be encouraged to attempt the investigation of the many physiological problems now pressing for a solution."

Dr. Bowditch's own investigations were almost as varied as those of the men who worked with him. His training in the Leipzig school, which was characterized by the application of physical principles to bodily processes, gave full play to his unusual inventive faculties. Simultaneous records on a single kymograph were suggested by him while in Leipzig, and this suggestion is said to have first directed the

attention of Ludwig to the young American's abilities. The contriving of the Bowditch clock was another product of the Leipzig experience. In the Harvard laboratory the invention of a new form of induction apparatus, with the secondary coil turning at various angles to the primary, and the devising of a new form of plethysmograph to register changes in the volume of organs, testify to his ingenuity.

That apparatus is a means to an end, however, he never forgot, and for many years he was engaged in researches of striking range and originality. Besides his investigations of the peculiar functions of cardiac muscle, he demonstrated the indefatigability of nerves, made interesting observations on the knee-jerk and conditions affecting it, performed experiments which showed the force of ciliary motion, studied the effects of different rates and intensities of stimulation on the action of vaso-motor nerves, conducted an exhaustive examination of the rate of growth of school-children, and collaborated with workers in still other fields of physiological science.

In the teaching of physiology Dr. Bowditch's instruction was marked by wide learning, clear discussion of controverted questions, cautious inference when convincing demonstration was not forthcoming, and orderly exposition. His lectures were unusually well illustrated, by methods which made lasting impressions. The sending of students to original sources for material for physiological theses was a notable contribution to educational procedure. The conferences at which the theses were read and the weekly quizzes were delightfully informal and conversational. For thirty-five years Dr. Bowditch continued his helpful relations to students of the Harvard Medical School. In 1876 he was made Professor of Physiology; and in 1903, when the George Higginson Professorship of Physiology was established, he was appointed first occupant of the chair.

Further service to physiology he performed by assisting to found the American Physiological Society, of which he was the second president. The character of the Society as an association of active investigators is largely the result of his initiative. His example and his frank appreciation of original work as it was newly reported at meetings of the Society were an important source of encouragement to young men beginning physiological investigation. The American Journal of Physiology also received his support from the time it was first suggested. Both the American Physiological Society and its journal have been of incalculable value in stimulating physiological and biochemical research in this country.

Dr. Bowditch's relations to medicine were not, however, confined to the advancement of physiology alone, taken even in the wide sense in

which he regarded it. His first larger allegiance was to the Harvard Medical School. He was prominent in the movement during the late 70's to secure a new home for the School, and helped to obtain the necessary funds for the building occupied from 1882 to 1906, at the corner of Boylston and Exeter Streets. In 1883 he was persuaded that as Dean he would have opportunities of increased usefulness to medicine. During the next ten years while he held the deanship, important changes were brought to pass in medical education. Bacteriology was introduced as a regular study, a pioneer venture under his leadership. The four years' required course was adopted, another forward step which the Harvard Medical School was among the first to take. A further important innovation was the calling of men from other universities to assume positions in the School, — Dr. W. H. Howell came from Michigan to be Associate Professor of Physiology, and Dr. W. T. Councilman came from Johns Hopkins to be Professor of Pathology. Although Dr. Bowditch resigned from the deanship in 1893, he never ceased to be interested in the larger problems of medical instruction. During his later years he became a strong advocate of greater freedom of election in medical study. Two of his addresses, "Reform in Medical Education" and "The Medical School of the Future," are admirable statements of the principles of sound teaching.

He was one of the first to foresee the necessity of enlarging the Harvard Medical School and bringing it into closer relations to hospitals. He became an enthusiastic promotor of the plan to make an important medical center of the Longwood Group of medical institutions, and with Dr. John Collins Warren, was astonishingly successful in securing funds for the realization of that great vision.

Among the most valuable of the larger services to medicine which Dr. Bowditch performed was his defense of animal experimentation against repeated attempts to pass unreasonable legislative restrictions. The success of the medical profession in Massachusetts in overcoming the misguided zeal of ignorant agitators has given heart to the profession elsewhere. The methods which were here used in meeting the petitioners for hostile legislation are now being employed in other states. In an address on "The Advancement of Medicine by Research" Dr. Bowditch clearly exposed the methods of the antivivisectionists, and presented an illuminating statement of the great benefits which had been secured for mankind by animal experimentation.

In spite of his large interest in medical research and education, he maintained useful relations with public affairs non-professional in character. From 1877 to 1881 he was a member of the Boston School Committee. He was President of the Boston Children's Aid Society and

helped to broaden its scope and importance. Between 1895 and 1902 he was happily engaged as trustee of the Boston Public Library. As a member of the Committee of Fifty on the Alcohol Problem, he submitted a report on the character of public school instruction regarding the effect of alcohol, and urged that that instruction should be made to accord with scientific fact.

For his important services he was widely honored. He was elected a fellow of the American Academy of Arts and Sciences in 1872. During the year 1877 he was its Recording Secretary, and from 1881 to 1883 a member of its Council. For twenty-two years he served on the Library Committee. He was also a member of the American Philosophical Society of Philadelphia, the National Academy of Sciences, and many other scientific bodies in this country. The Royal Society of Medicine and Natural Science of Brussels, the Academy of Science of Rome, and other foreign societies enrolled him among their members. The University of Cambridge made him Doctor of Science in 1898; and Edinburgh (1898), Toronto (1903), Pennsylvania (1904), and Harvard (1906) gave him the degree of Doctor of Laws.

Everyone who came in close contact with Dr. Bowditch was impressed by his rare combination of sure and sober judgment with vigorous will and readiness of action, — qualities which made him a natural leader. Furthermore his mind was fertile with ingenious and effective ways to secure the accomplishment of worthy ends. He was eminently single-minded; the matter in hand was always the important matter to be attended to. Persons who knew him well recall that he seldom spoke of the past, almost never of his experiences in the War, and rarely of his earlier researches. The forward look to the fulfilment of plans already started was characteristic of him to the last. These qualities of energetic leadership were tempered by unfailing courtesy, fairness, and good-will, and warmed by a delightful sense of humor. These lovable characteristics brought to him the friendship and lifelong devotion of the foremost men of medical science, as well as of his students and his associates in various activities. Friendship was to him a blessing to be cultivated. He rejoiced in having his friends with him at his beautiful home in Jamaica Plain, and in his summer camp in the Adirondacks, or in going to be with them. Comrades of his Leipzig days visited him thus, as well as Sir Michael Foster, Professor Mosso, and Professor Waller. And he frequently renewed associations with them in Europe.

Although during the years from 1906 to his death Dr. Bowditch's vigor and activity were more and more limited by the advances of a paralysing disease, his mind remained clear and he continued much in-

terested, almost until the last, in plans he had outlined for the Medical School. In spite of the growing physical weakness which must have clouded for a time his energetic spirit during those years, Dr. Bowditch's life as a whole must be regarded as essentially a happy life, happy in durable achievements, happy in the affections of close friends, and in the tender devotion of his family. When it became necessary for him to face the inevitable, he accepted his fate with cheerful patience and with gentlest consideration for those who ministered to him. Perhaps as the end approached he recalled the words which he wrote in a memorial to his friend, Theodore Lyman, years before: —

"I remember, Mr. President, when a young man, looking around among the men of my generation and considering whose lot in life seemed to me, on the whole, the most enviable. I came to the conclusion that Theodore Lyman was, of all my acquaintances, the man for whom the future seemed to hold out the brightest promise.

"In vigorous health, with a personality — physical, mental, and moral — which endeared him to all who came in contact with him, happily married, with instincts and powers which led him to the highest callings, to the service of his country in the field and in legislative halls, with tastes for the study of the natural sciences and abundant means to gratify them, there seemed to be nothing lacking to make his life an ideally happy one.

"Then, when the shadow of a slow, insidious disease fell upon him it seemed for a time as if his life were but to afford another illustration of the old Greek saying that no man is to be judged happy before his death; but when I saw how bravely he met the advances of his enemy, and with what courageous cheerfulness he interested himself in the pursuits of his friends and in the active life around him in which he could no longer share, I could not help feeling that a happiness was reserved for him higher than any of which the Greek philosopher had dreamed or I, as a young man, had formed a conception — the happiness of knowing that by the force of his example he had helped to raise those who came under its influence to a higher and nobler life."

W. B. Cannon.

List of Publications by Dr. H. P. Bowditch.

1871 Über die Eigenthümlichkeiten der Reizbarkeit, welche die Muskelfasern des Herzens zeigen. Arb. a. d. physiol. Anst. zu. Leipz., 1871, 139–176. Also: Ber. d. k. sachs. Gesellsch. d. Wissensch. Math. phys. Kl., 1871

1872 Über die Interferenz des retardirenden und beschleunigenden Herznerven. Arb. a. d. physiol. Anst. zu. Leipz., 1872. 259–280.

1873 The lymph spaces in fasciæ. Proc. Am. Acad., Feb. 11, 1873.

1874 Dr. Bowditch and Minot, C. S. The influence of anæsthetics on the vasomotor centres. Boston M. & S. J., 1874, xc, 493–498.

1875 A new form of inductive apparatus. Proc. Am. Acad., Oct. 12, 1875.

1876 Force of ciliary motion. Boston M. & S. J., 1876, xcv, 159–164.

1877 The growth of children. 8th Annual Report of the State Board of Health of Mass., Boston, 1877, 275.

1878 Does the apex of the heart contract automatically? J. of Physiol., 1878, i, 104–107.

1879 The growth of children, a supplementary investigation, with suggestions in regard to methods of research. 10th Annual Report of the State Board of Health of Mass., Boston, 1879, 33–62.

1879–80 Dr. Bowditch and Garland, G. M. The effect of the respiratory movements on the pulmonary circulation. J. of Physiol., 1879–80, ii, 91–109.

1879 A new form of plethysmograph. Proc. Am. Acad., May 14, 1879.

1879–80 Physiological apparatus in use at the Harvard Medical School. J. of Physiol., 1879–80, ii, 202–205.

1881 The relation between growth and disease. Trans. Am. Med. Ass'n., 1881, xxxii, 371–377.

1880–82 Dr. Bowditch and Southard, W. F. A comparison of sight and touch. J. of Physiol., 1880–82, iii, 232–245. Also abstract of same.

1880–82 Dr. Bowditch and Hall, G. S. Optical illusions of motion. J. of Physiol., 1880–82, iii, 297–307. Abstract of above.

1882 Dr. Bowditch and Harris, F. A. On the collection of data at autopsies. Boston M. & S. J., 1882, cvii, 365.

1883 Dr. Bowditch and Warren, J. W. Plethysmographische Untersuchungen über die Gefässnerven der Extremitäten. Centralbl. f. d. med. Wissensch., 1883, xxi, 513.

1885 Note on the nature of nerve-force. J. of Physiol., 1885, vi, 133–135.

1886 What is nerve-force? Proc. Am. Ass'n. Adv. Sc., 1886, xxxv, 237–246.

1886 Dr. Bowditch and Warren, J. W. Plethysmographic experiments on the vasomotor nerves of the limbs. J. of Physiol., 1886, vii, 416–450.

1886 Vaso-motor nerves of the limbs. Abstract of foregoing paper. Proc. Am. Ass'n. Adv. Sc., 1886, xxxv, 270.

1887 The action of sulphuric ether on the peripheral nervous system. Am. J. Med. Sc., Apr., 1887.

1888 The reinforcement and inhibition of the knee-jerk. Boston M. & S. J., 1888, cxviii, 542–543.

1890 Dr. Bowditch and Warren, J. W. The knee-jerk and its physiological modifications. J. of Physiol., 1890, xi, 25–64.

1890 The physique of women in Massachusetts. 21st Annual Report of the State Board of Health of Mass., 1889, Boston, 1890, 287–304.

1890 Über den Nachweis der Unermüdlichkeit des Säugethiernerven. Arch. f. Physiol., 1890, 505–508.

1890 The growth of children studied by the method of percentile grades. Internat. Med. Congress, Berlin, 1890.

1891 The growth of children studied by Galton's method of percentile grades. 22d Annual Report of the State Board of Health of Mass., Boston, 1891, 479–522.

1894 Are composite photographs typical pictures? McClure's Mag. Sept., 1894.

1895 A card catalogue of scientific literature. Science, Feb. 15, 1895.

1896 The advancement of medicine by research. Boston M. & S. J., 1896, cxxxiv, 577–581. Proc. of Mass. Med. Soc., 1896.

1897 Memoir of Charles Edouard Brown-Sequard. (1817–1894.) Read before the National Academy, April, 1897.

1898 Reform in medical education. Science, Dec. 30, 1898; and Boston M. & S. J., 1898, cxxxix, 643–646.

1898 Apparatus for illustrating movements of the eye. Boston Soc. Med. Sci., June, 1898.

1900 The medical school of the future. Trans. of the 5th Congress of the American Physicians and Surgeons, May, 1900; and Philadelphia Medical Journal, May 5, 1900.

1904 The study of physiology. Univ. of Pa. Medical Bulletin, June 1904.

Two Resident Fellows have resigned.

New members elected are: — Resident Fellows, six; Associate Fellows, one.

The roll of the Academy now includes 194 Resident Fellows, 76 Associate Fellows, and 55 Foreign Honorary Members.

RUMFORD PREMIUM.

In conformity with the terms of the gift of Benjamin, Count Rumford, granting a certain fund to the American Academy of Arts and Sciences, and with a decree of the Supreme Judicial Court for carrying into effect the general charitable intent and purpose of Count Rumford, as expressed in his letter of gift, the Academy is empowered to make from the income of said fund, as it now exists, at any Annual Meeting, an award of a gold and a silver medal, being together of the intrinsic value of three hundred dollars, as a premium to the author of any important discovery or useful improvement in light or in heat, which shall have been made and published by printing, or in any way made known to the public, in any part of the continent of America, or any of the American islands; preference being always given to such discoveries as shall, in the opinion of the Academy, tend most to promote the good of mankind; and to add to such medals, as a further premium for such discovery and improvement, if the Academy see fit so to do, a sum of money not exceeding three hundred dollars.

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